THE JOURNAL OF AGRICULTURE

OF WESTERN AUSTRALIA

EXD!

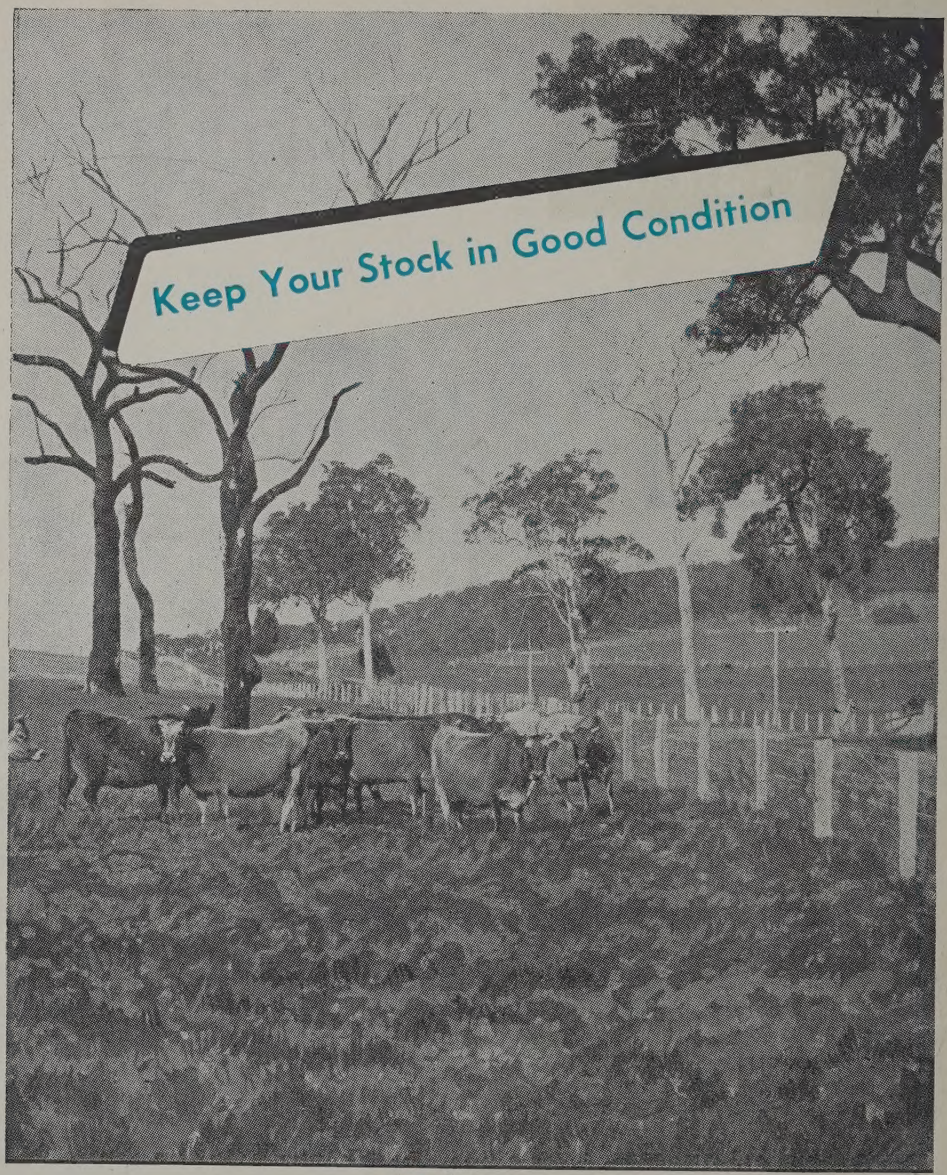
COMMONWEALTH INST.
ENTOMOLOGY LIBRARY
29 APR 1955
SERIAL Aus. 30
SEPARATE

VOL. 4 No. 1 (Third Series)

JANUARY—FEBRUARY 1955

PRICE 2/-

Registered at the G.P.O., Perth, for transmission by post as a periodical.



with WESFARMERS **CATTLE LICKS**

Formulated to help overcome mineral deficiencies - - should be available to the animals at all times

The JOURNAL OF THE DEPARTMENT OF AGRICULTURE
WESTERN AUSTRALIA

VOL. 4 (Third Series) JANUARY – FEBRUARY, 1955 No. 1

Published every second month by the Department of Agriculture, St. George's Terrace, Perth

The subscription rate (which includes postage) is 10s. per annum. Single copies 2s. each

Edited by
J. A. MALLETT

Articles which appear in the "Journal" may be reprinted, provided that the "Journal" and the authors are acknowledged.

Issued by direction of
THE MINISTER FOR AGRICULTURE

COVER PICTURE

At a time when most pasture paddocks are dry and brown, a portion of the Denmark Research Station herd of pedigreed Guernseys finds lush grazing in the "Deep South"

IN THIS ISSUE

Wild Dogs and Dingoes in Western Australia — A. R. Tomlinson — 5

Paints and Painting — 23

Noogoora Burr — G. R. W. Meadly — 33

Wheel Slip in Tractor Operation — F. R. Stanley — 39

Copper & Cobalt Deficiency of Livestock in Western Australia — H. W. Bennetts — 43

Clover Disease — F. L. Shier and R. C. Rossiter — 65

Maize Grain Trial — F. E. Ryan — 71

Insect Pests—The Climbing Cutworm — C. F. H. Jenkins — 75

Buffel Grass — K. Fitzgerald — 83

Leucosis in Fowls — P. M. A. Harwood — 93

Lice and Tick in Sheep — C. R. Toop, C. F. H. Jenkins and W. L. McGarry — 97

Books for Farmers — 111

Shearing Schools — W. L. McGarry, J. Reilly and M. Butler — 113

Hormones Change Vineyard Practice — 115

Buy a Filing Case for Your Journals — 117

The Loss in Weight of Stored Jonathan Apples — F. Melville — 119

Farm and Home—Summer Desserts; A Millinery Hood Makes a Novel Basket — Brenda Cleeve — 121

Sunrise and Sunset Tables — 128

By Authority: WILLIAM H. WYATT, Government Printer, Perth.

81835/12/54—13,750

THE DEPARTMENT OF AGRICULTURE
of
WESTERN AUSTRALIA

Minister for Lands and Agriculture:
THE HON. E. K. HOAR, M.L.A.

Director of Agriculture:
G. K. BARON HAY.

Deputy Director of Agriculture:
I. THOMAS.

Chief Administrative Officer:
W. HOPKINSON

Controller of Abattoirs.—T. C. ROWLANDS.
Rural Economic Adviser.—R. P. ROBERTS.
Chief Clerk.—A. W. R. HUME.
Editor, "Journal of Agriculture."—J. A. MALLETT.
Librarian.—MISS A. E. M. White.

ANIMAL DIVISION

Chief Veterinary Surgeon and Chief Inspector of Stock.—C. R. TOOP.
Assistant Chief Veterinary Surgeon.—E. F. TWADDLE.
Veterinary Surgeons.—J. SHILKIN; J. CRAIG; P. M. A. HARWOOD; J. M. ARMSTRONG (Head Office), R. HARLEY; P. B. LEWIS (Bunbury).
Stock Inspectors.—J. F. ROBINSON; S. COOK; B. D. HOOPER; A. C. LINTO; J. MITCHELL (Head Office), J. R. BLACKBURN; R. J. CARROLL; W. BOOTH (Bridgetown), C. R. DIXON (Bunbury), T. INGATE (Derby), E. S. M. SMITH (Geraldton), E. G. McKENZIE (Kalgoorlie), J. J. FREETH (Kellerberrin), A. K. AITKEN (Midland Junction), D. G. STRANG (Moora), C. V. HADLEY (Mt. Barker), N. W. FROOME (Wagin), E. C. GOLDRING (Wallal).

ANIMAL HEALTH AND NUTRITION LABORATORIES

Principal.—H. W. BENNETTS.
Animal Nutrition Officer.—L. C. SNOOK.
Veterinary Pathologist.—J. E. PETERSON.
Biochemist.—M. C. NOTTLE.
Manager, Bramley Research Station.—N. A. SCOTT.

POULTRY BRANCH

Officer-in-Charge.—R. H. MORRIS.
Advisers.—D. K. GILES; L. J. GAFFNEY.
Instructors.—A. R. WRIGHT; R. VAGG.
Inspector.—W. WARD.

BRANDS

Registrar of Brands.—A. R. TOMLINSON.

HORTICULTURAL DIVISION

Superintendent of Horticulture.—H. R. POWELL.
Assistant Superintendent.—T. C. MILLER.
Viticulturist.—W. R. JAMIESON.
Advisers.—F. MELVILLE; S. HARDISTY; K. T. WHITELY.
Senior Instructor.—T. F. HERLIHY.
Packing Instructor.—J. S. BLOOMFIELD.
Instructors.—A. T. GULVIN (Albany); R. G. CAHILL (Bridgetown); A. BRIMSON (Chittering); J. C. ROWBOTHAM (Donnybrook); R. L. CAILES (Kalamunda); H. ARGYLE (Kelmscott-Armadale); W. J. RENNICK (Manjimup); L. G. HAYWARD (Mundaring); V. CAHILL; W. CAMPBELL (Nannup).
Inspectors.—J. F. S. MAUNSELL; J. SLAMON; W. J. PHARAZYN (Ports); E. H. RAWSON, W. WEAR (Markets); W. WARDELL-JOHNSON (Kalgoorlie).
Senior Fruit Fly Inspector.—E. H. ELKINGTON.
Fruit Fly Inspectors.—E. BADHAM; A. FORSYTH; F. JACKSON; A. B. THOMAS; A. SIBSON (Metropolitan); S. WILLIAMS (Bunbury); M. EVANS (Chittering); N. BROCKMAN (Donnybrook); I. RENNIE (Harvey); L. NEAVE (Kalamunda); A. O. WELLS (Kelmscott); J. L. LITTLELY (Mundaring); G. DIGNEY (Pinjarra); L. ROLINSON (Swan).

VEGETABLE BRANCH

Officer-in-Charge.—J. P. ECKERSLEY.
Assistant Officer-in-Charge.—J. P. FALLON.
Advisers.—D. JOHNSTON; T. WACHTEL.
Instructors.— J. C. PALMER; M. HARDIE; J. NAJMAN (Albany); G. C. DE HAAN (Manjimup).
Inspectors—F. H. TONKIN; J. STEELE; H. V. STOVOLD (Metropolitan); F. HERBERT (Geraldton).
Research Station Manager.—D. C. FOURACRES.

TOBACCO BRANCH

Officer-in-Charge.—T. G. HANEY.
Instructor.—R. KLANJSCEK.
Field Technician.—H. G. MORTLOCK.

APICULTURAL BRANCH

Government Apiculturist.—R. S. COLEMAN.
Technician.—A. C. KESSELL.

DAIRYING DIVISION

Superintendent of Dairying.—M. CULLITY.
Assistant Superintendent.—H. G. ELLIOTT.
Agrostologist.—F. E. RYAN.
Advisers.—B. WILLIAMS, D. N. TULLOCH, K. M. HOPE, F. BRIDGMAN (Head Office); A. W. HOBBS (Bridgetown); K. NEEDHAM (Busselton); A. SHARP (Bunbury); A. BETTENAY (Denmark); A. E. BAKER (Manjimup).
Wokalup Research Station.—R. G. WOODWARD.
Officer-in-Charge, Dairy Factory and Produce Inspection.—H. M. LISTER.
Dairy Produce Inspector.—A. H. HOBBS.
Instructors.—N. INGLETON, G. R. W. SCOTT, H. J. WEST (Head Office); D. C. MICKLE (Bunbury); H. MASLIN (Capel); J. T. McNALLY (Manjimup).
Pure Bred Herd Records.—J. A. DARRAGH; G. D. BASTYAN.
Research Station Managers.—V. WESTON (Denmark); K. W. SIMES (Wokalup).

WHEAT AND SHEEP DIVISION

Superintendent of Wheat Farming.—F. L. SHIER.
Assistant Superintendent.—A. S. WILD.
Plant Geneticist.—J. T. REEVES.

Advisers.—H. G. CARISS, N. DAVENPORT, H. M. FISHER, W P. CULLINANE, A. F. SMITH (Head Office); J. C. GRASBY (Avondale); C. M. RALPH (Esperance); G. L. THROSSELL (Geraldton); T. E. McDOWELL (Katanning); H. G. NEIL, G. T. HALPIN, G. R. GREWAR (Moora); B. F. CARLIN (Mt. Barker); L. D. WHITE (Narrogin).

Instructor.—J. W. GILCHRIST (Geraldton).

Research Station Managers.—J. C. GRASBY (Acting Manager, Avondale); D. HOGBEN (Chapman); F. C. F. GISHUBL (Merredin); R. L. DOWN, E. B. NORRIS (Asst. Manager, Salmon Gums and Esperance Plains); R. R. BATEMAN (Wongan Hills).

SHEEP AND WOOL BRANCH

Sheep and Wool Adviser.—W. L. McGARRY.

Sheep and Wool Instructor.—J. REILLY.

Shearing Instructor.—M. BUTLER.

SEED CERTIFICATION AND WEED BRANCH

Officer-in-Charge.—G. R. W. MEADLY.

Botanists.—B. J. QUINLIVAN; G. A. PEARCE.

Weed Control Officers.—K. RYAN (Metropolitan); J. N. HUTCHINSON (Bunbury); N. S. MARR (Geraldton); E. G. McKENZIE (Kalgoorlie); W. H. JOHNSON (Katanning); C. V. CAHILL (Northam).

SOIL CONSERVATION DIVISION

Commissioner of Soil Conservation.—G. H. BURVILL.

Assistant Commissioner.—L. C. LIGHTFOOT.

Senior Soil Research Officer.—S. T. SMITH.

Advisers.—J. E. WATSON; D. J. FLEAY; G. W. SPENCER; B. a'B. MARSH; T. C. STONEMAN; D. J. CARDER; J. L. McMULLAN.

Clearing Control Inspector.—W. BRYAN.

IRRIGATION BRANCH

Officer-in-Charge.—H. J. K. GIBSONE.

Assistant Officer-in-Charge.—G. GAUNTLETT.

Adviser.—K. S. COLE.

Technicians.—G. C. BROWN; H. B. WILSON; A. H. BOSCH.

RESEARCH DIVISION

Chief Plant Nutrition and Research Officer.—T. C. DUNNE.

Senior Plant Nutrition and Research Officer.—L. T. JONES.

Research Officers.—J. A. PARISH; N. J. HALSE; E. N. FITZPATRICK.

MURESK AGRICULTURAL COLLEGE

Principal.—W. SOUTHERN.

Assistant Principal and Senior Lecturer.—A. J. T. MARSHALL.

Science Lecturer.—G. D. RIMES.

Lecturer, House and Sports Master.—J. M. MASON.

Factory Superintendent and Lecturer.—H. M. LISTER.

Farm Manager and Demonstrator.—H. A. LOVEGROVE.

Assistant Lecturer in Agriculture.—J. WALKER.

Dairy Instructor.—W. BRIDLE.

Piggery Instructor.—P. GARSTONE.

Poultry Instructor.—A. M. GARDINER.

Horticultural Instructor.—R. A. HILL.

Sheep Instructor.—H. P. DWYER.

Farm Engineering Instructor.—J BRISTOW STAGG.

Building Instructor.—P. St. QUINTIN.

MISCELLANEOUS BRANCHES

BOTANICAL BRANCH

Government Botanist and Curator of State Herbarium.—C. A. GARDNER.

Senior Botanist.—R. D. ROYCE.

PLANT PATHOLOGY BRANCH

Government Plant Pathologist.—W. P. CASS SMITH.

Senior Plant Pathologist.—H. L. HARVEY.

Plant Pathologists.—Miss O. M. GOSS; R. F. DOEPEL; Miss R. McALEER

ENTOMOLOGY BRANCH

Government Entomologist.—C. F. H. JENKINS.

Senior Entomologist.—P. N. FORTE.

Entomologists.—D. G. SHEDLEY; B. A. B. EDWARDS; Miss J. ROBERTSON; J. BUTTON.

VERMIN CONTROL BRANCH

Chief Vermin Control Officer.—A. R. TOMLINSON.

Assistant Chief Vermin Control Officer.—J. S. CRAWFORD.

Senior Vermin Control Officer.—C. MARSHALL.

Research Officer.—C. D. GOODING.

Research Technicians.—L. A. HARRISON; J. L. LONG; S. SCHNEIDER.

Vermin Control Officers.—C. K. BLAIR (Northern Areas); A. G. MOORE (Southern Areas); R. J. FRASER (North-West); P. J. McDONALD (Kimberleys); G. E. MILES (Upper Great Southern); H. HART (Northern Agricultural Areas); B. T. F. EVANS (Coastal Areas); A. G. VEITCH (Central Wheatbelt); S. M. HARVEY (South-West); J. W. LEIGHTON; G. D. ATKINSON; D. J. KING; E. A. McHUGH; J. HOWE; J. C. McSWAIN; R. H. TAYLOR; A. J. TOZER; G. V. CROOKE; C. J. WOODBURY.

Vermin Fence Inspectors.—R. CORNEY (Yalgoo); G. E. RICHARDS (Burracoppin).

NORTH-WEST BRANCH

Officer-in-Charge.—W. M. NUNN.

Agrostologist.—B. RUMICH.

Tropical Adviser.—J. J. C. SUCKLING.

Agricultural Advisers.—H. SUIJDENDORP (Gascoyne Research Station); J. LAWSON (Derby); J. B. RITSON (Kimberley Research Station).

Cattle Adviser.—G. A. SMITH (Broome).

Research Station Managers.—R. G. NAILARD (Gascoyne); N. A. BRETT-YOUNG (Kimberley).

ARE YOU ON OUR MAILING LIST?

"The Journal of Agriculture of Western Australia" is posted free of charge to bona fide farmers. If you are a farmer and would like to receive the Journal, write to the Editor, "Journal of Agriculture," Department of Agriculture, Perth, giving your name and address (block letters please) together with your location number.

Non-farmers may receive the Journal (six issues a year at two-monthly intervals) on payment of an annual subscription of 10s.

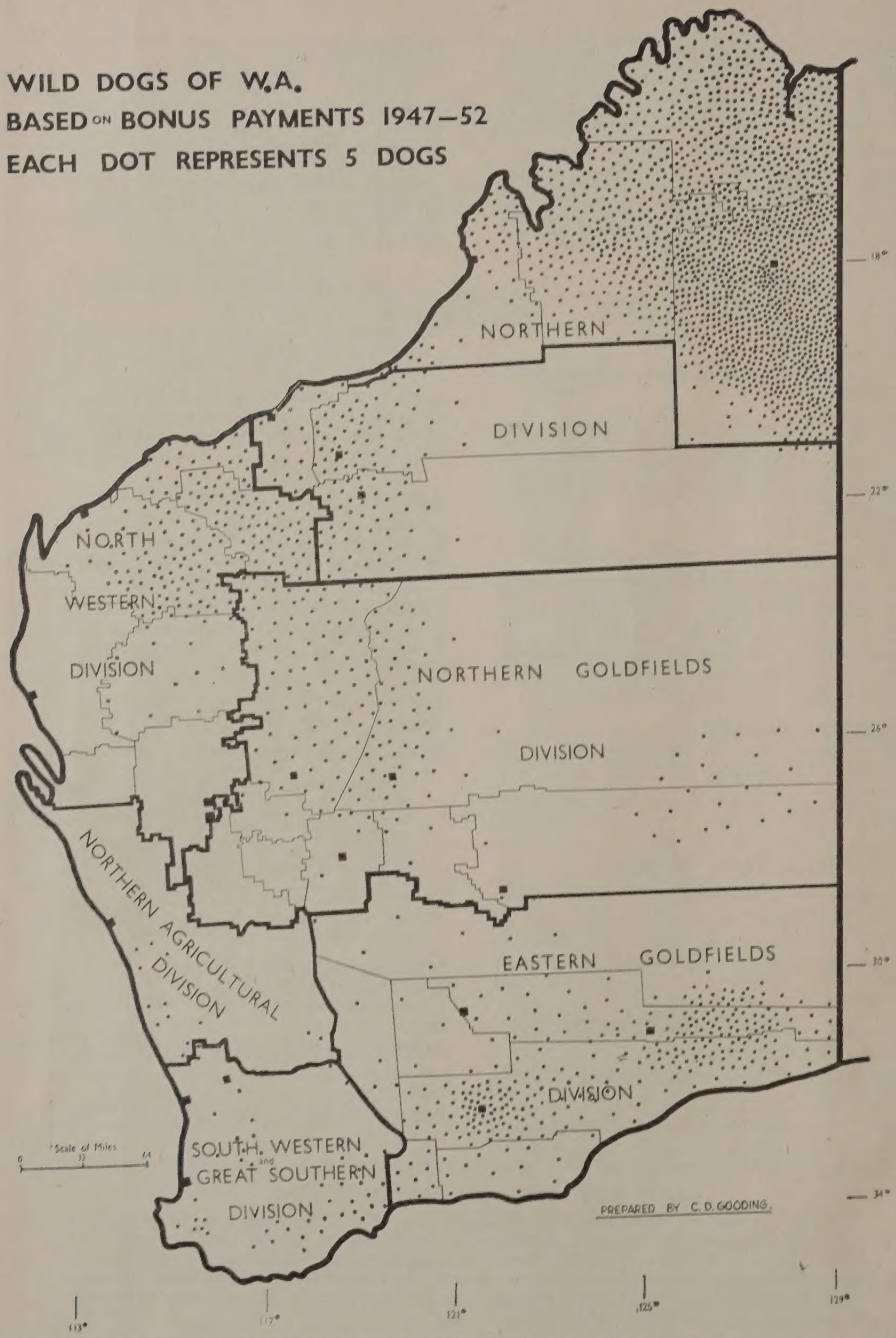


Fig. 1.—Map showing distribution of wild dogs, according to scalp bonuses paid.

WILD DOGS AND DINGOES IN WESTERN AUSTRALIA

By A. R. TOMLINSON, Chief Vermin Control Officer

WILD dogs have presented a major problem ever since stock raising was commenced in Western Australia. While the intensity of the menace has moved outwards as settlement advanced, the problem is still acute in the outback and sufficiently serious within many settled areas to cause concern. It is felt that a review of the situation may assist farmers, pastoralists and others concerned by giving them a better idea of the extent of the problem, the manner in which the Government and other authorities are tackling it and some proposed future moves.

The first recorded figure for Government bonus payments in Western Australia was for 6,200 scalps paid for at 10s. each in 1923. These 10s. payments continued until a £2 bonus was instituted in 1928, following upon the creation of the Vermin Act Trust Fund in 1927.

In the 26 years from July 1, 1927, to June 30, 1954, 338,881 wild dog scalps have been received and payments from the Vermin Act Trust Fund have been £382,539. As indicated on Table 1, 15,342 scalps were received during 1927-28 while 10,260 were received in 1953-54, and the highest number was 19,694 in 1944-45.

Many thousands of pounds have been expended by Vermin Boards and primary producers in additional bonuses, losses in stock have been very costly (some properties have been abandoned as a result of sheep losses), while expenditure in poisons, traps and man-power has brought the total cost to millions of pounds.

DISTRIBUTION

Some idea of the distribution of wild dogs (the term is used to include dingoes, domestic dogs gone wild, or crosses of these two) may be gained from the map showing the average number of scalps produced for payment of the bonus each year over a recent. five-year period. It will be observed that the greatest concentration is in the northern or Kimberleys area of the State; there is a further concentration in the North-West, which tapers away from the coast towards the South-East; with a further series of concentrations in the vicinity of the Nullarbor Plain, the Warburton Ranges and the Eastern Goldfields; and small numbers in the agricultural districts.

The dots have been shown in the districts of the local authorities which collected the scalps, and have been grouped within the limits of settlement or where it is known that doggers operate. For instance, the southern border of the dots in the Kimberleys and the eastern border in the North-West are the limits to which stations extend.

There are wild dogs beyond these limts as they will be found right to the border of Western Australia and beyond. For this reason, a map based on bonus payments cannot be expected to be completely ac-

Fig. 4.—Aerial baiting of outback breeding areas checks wild dog invasion at the source. Sacks of prepared baits shown ready to be loaded on the aircraft at Balfour Downs Station.

The overall figures for pastoral districts are 12,093 in 1928 and 10,260 in 1954. The lowest was 6,303 in 1932 and the highest 19,288 in 1945.

DIFFICULTIES ASSOCIATED WITH CONTROL

The problem of effective control is subject to several difficulties, which include:—

(1) **The breeding rate.** Each pair will have a litter of five to six or even as many as nine pups a year. A small residual population can rapidly build up its numbers. As the parents endeavour to hide the litters in remote and inaccessible places, they are difficult to destroy. This aspect is part of the principles regulating animal populations which is generally recognised. Briefly speaking, there is normally an average population of any wild animal which persists despite violent fluctuations due to disease, seasonal conditions and many other factors. The average population is controlled by many things, among the chief being availability of food, living space and breeding grounds.

The net result is that, the more violent the interference with this average population, the stronger is nature's endeavour to return to the average level. By an artificial population reduction the breeding rate is increased and the natural mortality rate is reduced by the lack of competition for food and living space.

This principle must be recognised, as it explains largely why, although large numbers of wild dogs are destroyed, the general population level may remain the same. Increase in food, by the presence of rabbits or sheep, will also increase the average population level.

Destruction of dogs before or after they reach settlement means reduced losses of stock. However, permanent reduction of the wild dog populations requires reduction of their food supplies (which is unlikely in settled areas), destruction of breeding and living habitats by the advance and intensification of settlement, or destruction measures which consistently destroy the dogs faster than the breeding rate. Excellent examples of control through destruction work were given in the South-West corner and the Midlands area to the north of Perth, where continued heavy baiting by Government doggers reduced the wild dog populations to a minimum. When the baiting was relaxed the wild dog numbers increased.

(2) **Migrations, emigrations and other movements**: While, once they settle in an area, wild dogs normally have regular main dens or hide-outs, they are constantly moving and patrolling over their hunting grounds, which may extend over a considerable distance. They move away from these haunts and range far and wide when mating and return for whelping. They also

migrate with seasonal conditions and follow the movements of game. There is also fairly conclusive evidence of emigrations, sometimes on a large scale, over long distances, usually following particularly harsh seasonal conditions.

It is hoped to confirm the exact extent of these emigrations by tagging, but there seem to be repeated southerly and westerly movements from the drier inland districts into settlement. Some of the main routes, which observations indicate are followed, are shown on the accompanying map. One, starting in the Warburton Ranges near the central east border of the State, goes through the Nullarbor Plain to the south of Kalgoorlie and eventually to Mt. Manypeaks near Albany. It is unlikely that any single dog traverses this 900-mile route, but there is a series of connected staging and breeding localities along which the southerly and westerly movement of the dogs appears traceable. The wild dogs seem to favour certain well-defined travelling trails, usually following water supplies and breaks in the country which make travelling easier. Some are natural routes, such as the one already mentioned originating from the Warburton Ranges. Others are along man-made trails, such as the Canning Stock Route, originating in the East Kimberleys and reaching Wiluna and the motor "road" from the Warburton Range Mission to Laverton. (Of course, these man-made trails would also be following suitable travelling routes.) When cattle are driven down the Canning Stock Route, their arrival at Wiluna is usually followed by an invasion of wild dogs into the surrounding country.

In addition, evidence has accumulated of other regular infiltrations of wild dogs into settlement.

(3) **Domestic dogs:** There is always a steady drift of domestic dogs to swell the ranks of the wild dogs. They are town dogs, station or farm dogs and natives' dogs, which may have been well-behaved domestic dogs during the day, but savage blood-lusting killers at night. Unless detected by their owners, most of them go completely wild eventually. Some mate with other domestic dogs while others cross with dingoes, adding to the problem. An interesting example is in the coastal areas immediately to the north of Perth, which is completely surrounded by settlement so that there can be no infiltration by dingoes. Most of the wild dogs here are typical domestic dogs. "Kangaroo dogs" (a staghound like type) are prominent.

The extent to which cross-breeding continues is a matter of much conjecture. It is reasonably certain that domestic dogs and dingoes mate and litters are produced. It has been suspected, but not proved, that cross-breeding continues with the progeny although close inquiries and investigations

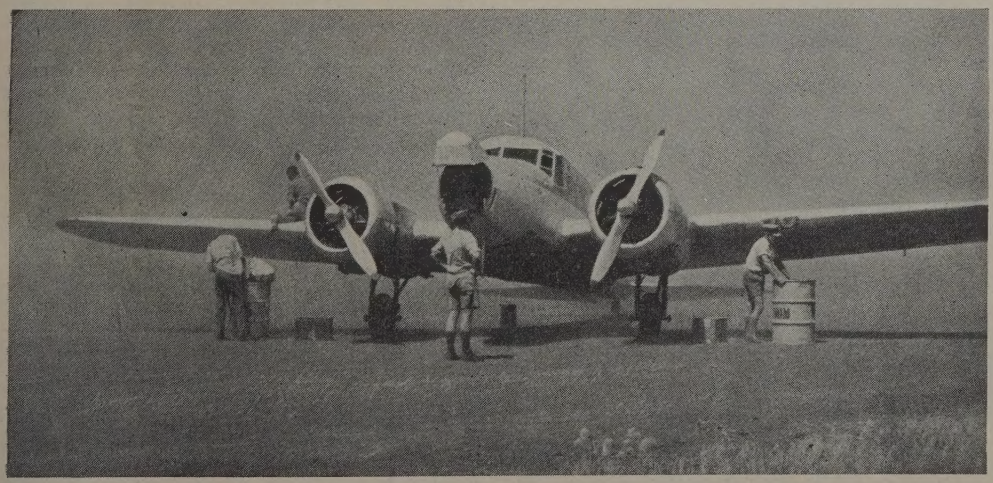


Fig. 5.—Refuelling the baiting aircraft at Ashburton Downs Station.

Fig. 6.—Carcass poisoning accounted for three dingoes shown here.

have failed to reveal any known instances. It has now been fairly well established that many suspected crosses are in fact pure dingoes with variations in colour, size, length of fur, etc. Mr. C. K. Blair (the Government Vermin Control Officer in charge of dogging operations in pastoral districts) reported the natives in the Warburton Ranges as describing three distinctively marked and varying sized classes of dingoes with different habits.

(4) **Cattle Stations.** Although there is ample proof that wild dogs kill and injure calves (one dogger found the remains of eight calves killed by dogs near a pool), most cattle station owners are uninterested in control work. Many do not agree that wild dogs do any damage to cattle, while others, who agree, do not think their losses are sufficiently serious to justify any special action. As a matter of fact, one reliable northern cattleman recently reported that wild dogs destroyed 96 out of 100 calves in one mob of his cattle.

Extreme difficulty is encountered in persuading cattle stations to take any effective action against dogs. In the North-West and the Eastern Goldfields, where cattle and sheep stations are adjoining, it is difficult to organise district-wide destruction drives for this reason.

With the exception of an area along the Fitzroy River to the south-west, the Kimberleys are given over to cattle raising. It is here that possibly the greatest problem in wild dog control is encountered The attitude on many cattle stations is that the wild dogs are not a menace and that the bonuses are a profitable side-line for station hands and others. Few of the cattle stations carry out any organised control measures by poisoning and what dogs are destroyed are shot or trapped for the bonus. As a result, the area might be described as a gigantic natural dog farm. It is significant that 5,338 of the 10,260 dog scalps produced in 1954 (over 52%) came from the Kimberleys.

The Kimberley dog population is isolated from the rest of the State geographically and it has been suggested that, as some of the vermin boards and stations are disinterested in control, payment of bonuses and other assistance should be stopped in this area. However, this would react unfavourably on the sheep stations and no doubt the Northern Territory would suffer from an increase in scalp payments.

THE BONUS SYSTEM

There is mounting evidence that the bonus system has been a costly failure. It may seem paradoxical that a system which results in many scalps being produced should be condemned, but such is the case. Any scheme which encourages destruction methods which will lead to a bonus, rather than destroying the pests to eradicate them, must fail. Bonuses substitute commercialisation for eradiction and do in fact lead to vermin "farming."

The main arguments against the bonus system are:—

(a) The aim is to obtain the bonus instead of to destroy a maximum number of pests. Methods which will lead to the recovery of carcasses, such as trapping and shooting, are used in preference to mass destruction, such as wholesale poisoning, in which many carcasses will not be found.

(b) Property owners are inclined to leave it to the bonus to remove their pests and neglect systematic destruction work.

(c) Unless a very high bonus is paid, professional hunters will not operate. On the other hand, the higher the bonus, the greater the concentration on individual animals and also more malpractices arise. Where high bonuses have been offered in restricted areas, scalps have been smuggled in from many miles away. Government doggers have met with open hostility in some places where their poisoning oeprations have threatened wild dogs on which high bonuses are being paid.

(d) Bonuses lead to a type of "vermin farming." There are many examples of this, including the practice of pup catching without destroying the parents. Annual visits are paid to regular pupping places to catch the pups while great care is taken to leave the parents unharmed. In other places, dogging operations cease during the breeding period in order that pregnant females will be unmolested. In certain areas, where breeding places are near and well known, all destruction measures have been aimed at the overflow, leaving the main reservoir untouched.

(e) In the University of California publication "Control of the Coyote in California," by Joseph Dixon (1920), the author says "The bounty system is, at its best, well nigh futile; this is well illustrated by the Coyote Act of our own State which went into effect March 31, 1891, and was suspended September 30, 1892, after 187,485 dollars had been expended and little had been accomplished. It is the opinion of those who have made a study of this question that the bounty system is not only vastly expensive and productive of endless fraud, but that in no known case has it given any general or permanent relief."

In "Modern Methods of Predator Control" by Dorr D. Green, Chief, Branch of Predator and Rodent Control, U.S.A. Fish and Wildlife Service (1951), it is stated: "A number of recent experiences have demonstrated more clearly than before that bounties are seldom an effective and efficient method for promoting predator control."

These statements have been supported by opinions given by leading authorities and our own experience.

APPROACH TO WILD DOG CONTROL PROBLEM

For many years the payment of a bonus was considered the main means of controlling wild dogs in Western Australia. This largely entailed shooting and trapping.

The official approach has been undergoing changes to a more positive attitude over the years and it is hoped that all landholders and interested organisations will eventually be educated to a similar understanding of the situation. Many are already keen supporters.

General Policy.

The general policy is to encourage wholesale baiting of dogs in remote breeding areas as well as in and around settlement. It is considered that, to be really effective, the baiting should be organised by vermin boards in district-wide simultaneous drives in which all concerned by the problem should participate. Vermin boards should employ men to organise such drives as well as doggers to actually assist landholders. These drives should be assisted by trapping and shooting of difficult dogs on properties, the destruction of pups during the "pupping" season and aerial baiting when warranted.

Fig. 7.—Dale's Gorge Creek in the Hamersley Ranges, photographed from the baiting aircraft.

Protection Board Doggers.

To assist local authorities and landholders in controlling wild dogs, the Agriculture Protection Board is employing 40 doggers—24 in the pastoral areas and 16 in the agricultural areas. Those in the agricultural areas are under the immediate direction of a Vermin Control Officer stationed in the country. In the pastoral areas supervision is decentralised by having Vermin Control Officers stationed in the Kimberleys, the North-West and the Eastern Goldfields under the direction of a senior officer, who is directly in charge of vermin control in pastoral areas.

Fig. 8.—The notice on the tree says "Poisoned Baits Laid Here", but the dingo couldn't read.

The doggers concentrate on the destruction of wild dogs in the more remote and difficult breeding and hunting grounds away from settlement. They have large territories to cover and, in order that the most effective use is made of their services, they are not allowed to operate on occupied holdings although they may give advice and certain assistance.

Their work is wholesale baiting by either carcass-poisoning or the distribution of unlimited numbers of small baits. Trapping and shooting are limited to assisting the main poisoning programmes.

Protection Board Trappers.

As a means of direct assistance for landholders and vermin boards where wild dogs are causing damage and their destruction is beyond the skill of local people, the Agriculture Protection Board authorised the employment of expert trappers. Their services are to be available on a charge to cover the actual costs of employing them and they will operate on occupied holdings or elsewhere as required. Any farmers or pastoralists requiring these experts should apply through their local vermin boards.

Up to the time of writing (1954), two such trappers had been obtained for the agricultural areas, but none for the pastorial areas.

Farmers, Pastoralists and Vermin Boards.

The Government doggers are operating at about the peak of their efficiency within the limitations of men and finance available. It is clear that any further improvement in the overall situation rests with farmers and pastoralists, who are responsible for destroying dogs on and about their properties, and vermin boards, which have a duty to ensure that dogs are destroyed throughout their districts. The only way the vermin boards may do this is by the employment of inspectors to supervise and organise wild dog control work and to employ doggers to assist the landholders.

Aerial Baiting.

Distribution of baits from aeroplanes is being used by the Agriculture Protection Board as an extension of ground baiting by doggers. The main projects are being conducted in the North-West and Eastern Goldfields pastoral areas in October and May. Other projects are being commenced to the east of the Great Southern agricultural areas.

The baiting is carried out in areas which are too remote or inaccessible for ground operations. Breeding grounds, watering

places and routes leading to these localities are the main targets. Although the inaccessibility of the areas makes assessment of results difficult, observations made where possible have revealed that this form of baiting is achieving its purpose.

Baiting with Poisoned Baits.

Baits made of meat—preferably fatty meat—are very effective in control work. Baits about an inch cube containing at least half a grain of alkaloid strychnine (one-third of a grain is the lethal dosage), if distributed wholesale, will be successful. Brisket fat has been found very suitable and, for the aerial baiting, millions have been imported from Queensland, where they are prepared by salting and boiling. Each contains a half-grain alkaloid strychnine tablet and is wrapped in paper for preservation.

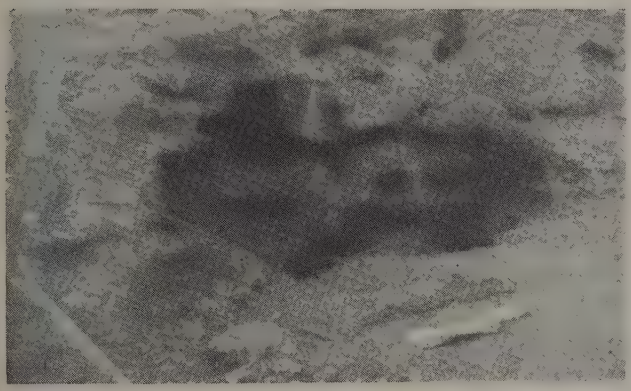


Fig. 9.—This cave in the South Stirlings contained three pups. Note the lamb's leg in foreground.

Baiting by Carcass Poisoning.

The Government doggers are achieving spectacular successes with carcass baiting. Carcasses of animals such as kangaroos and sheep are cut into sections, and strychnine powder—either alkaloid or soluble—liberally inserted in long cuts. Large kills (including one of 13 dogs) from single carcasses have been obtained and the advantage, as far as doggers are concerned, is that the dogs will usually remain in the vicinity of the carcasses until they die so that their scalps are easily secured. In many instances, carcass baiting has been the means of destroying particularly cunning dogs which have been difficult to trap.

Trapping.

Some individual dogs have been found very difficult to bait and trapping has been found necessary. The jaw of the trap must always be poisoned with strychnine to ensure that dogs do not die a lingering death or escape. Some skill is required in trapping and it is not advisable for anyone to undertake this means of destruction without some training. Otherwise there is a danger of a dog being "educated" so that it becomes "trap-shy" and very difficult to destroy.

Shooting.

A good marksman should always be armed when wild dogs are about. A .303 rifle is the most suitable.

Fencing.

Fencing has been found a very effective safeguard against wild dogs and some stations or farms could not have been carried on without "dog fences." The ideal dog-proof fence is 6ft. to 6ft. 6in. high, made of rabbit netting surmounted with larger mesh netting or closely laced wires. The top should lean outwards.

However, much lower fences have been found to be good safeguards. The South Australian dog fence is 4ft. 3in. high, while various stations and farms with rabbit fences increased to heights such as 3ft. 7in., 3ft. 6in., 4ft., 4ft. 10in. regard them as dog-proof. The West Australian vermin fences, which are 3ft. 10in., undoubtedly divert dogs and, where dogs have crossed, it is usually as a result of damage or gates left open.

No doubt dogs in pursuit of game or being chased would leap a fairly high fence or possible a domestic dog running wild might have been trained to do so. Normally wild dogs would not jump a fence of over 3ft. 6in. in height. It is of interest that, where a dog leaps a fence, it is usually a male. Bitches endeavour to scratch underneath.

General Destruction Programme.

While destruction work should be undertaken whenever necessary, there are certain periods most favourable or important.

Possibly the most favourable time is from October to January, when the pups are moving about, but are sufficiently inexperienced to be easily baited. The early part of this period coincides with the driest time of the year in most of the pastoral areas. During this period the dogs concentrate on watering places and are easy victims.

The mating period in the autumn just before the winter rains is another favourable time as the dogs are moving about and are less cautious than normally. Once again, they are concentrating near water. Immediately after the first rains they scatter and, although still vulnerable, are more difficult to find. However, this period is undoubtedly one of the most important in the programme as any destruction, particularly of bitches, curtails the potential population.

During the pupping season, which follows, an excellent opportunity is provided for destroying litters before they become killers.

Undoubtedly the most important time to destroy dogs is in the mating and breeding seasons, although possibly this is not the most favourable time.

FUTURE PROGRAMMES

While much investigational and research work is required, the better understanding of wild dogs and their habits is already leading to improved control measures.

Changes in Policy Required.

Generally speaking, it is considered that it will be essential to change from the limitations of the bonus system—even to abolishing the bonus—to a system of co-ordinated and organised control work extending over districts and groups of districts. Unless it is decided to introduce a system of centralised control, working in conjunction with local authorities and landholders (which is the most promising solution), no great progress will be obtained until vermin boards generally combine and organise drives throughout their districts.

Already the A.P.B.'s dogging scheme, with supervision in the hands of vermin control officers stationed in convenient centres, has laid the foundations for centralised control. Co-operative drives have been organised by these men and the ready support of landholders obtained.

Doggers.

The dogging scheme has been of inestimable benefit to pastoral and agricultural industries. The assistance and protection afforded by these men must have saved many thousands of pounds in stock production. The scheme should be maintained with as many men as finances will permit. The employment of doggers by vermin boards, to work with our men, would greatly assist.

Fig. 10.—Wild dog pups taken from a den in the South Stirlings.

Aerial Baiting.

Aerial baiting has an important place in any future scheme. Penetration to many remote places may be achieved only from the air. Intelligent combination of aerial baiting with ground operations is essential.

Investigations.

Research and investigations are to be continued, the more important phases being:—

(a) Expeditions to obtain further knowledge of the distant inland breeding areas, routes by which wild dogs emigrate to settlement and the reasons for these movements.

(b) Tagging to trace the movement of dogs and the distances they travel.

(c) Improved techniques to enable more effective destruction during the vital mating and breeding periods which offer the most favourable opportunity for ultimate successful control.

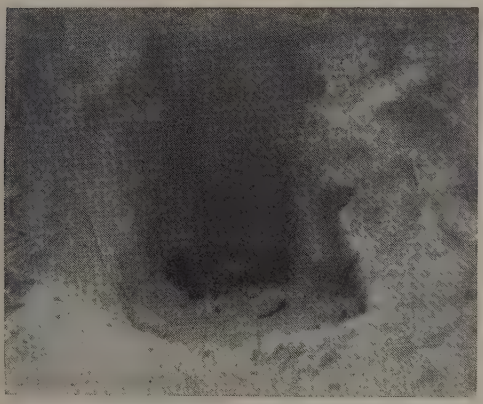


Fig. 11.—A litter of wild dog pups in a cave.

(d) Improved poisons and trapping devices. Investigations are being conducted into promising new poisons, such as the fluorines, including sodium fluoroacetate ("1080") and sodium fluoracetemide. Supplies of "cyanide gun" traps have been obtained for testing purposes.

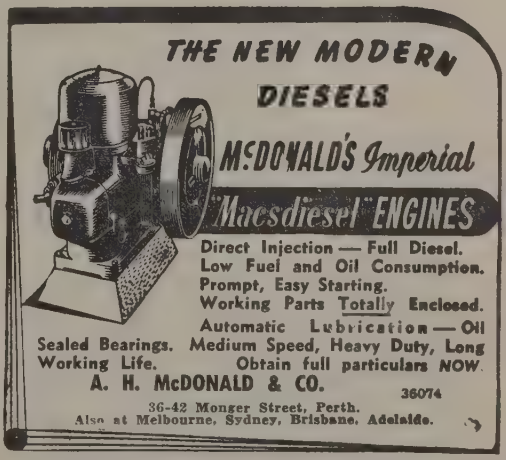
(e) Cross-breeding of domestic dogs and dingoes to prove conclusively that this does occur and to ascertain to what extent any progeny will breed.

Domestic Dogs.

While domestic dogs are so freely available to swell the ranks of the wild dogs, experience has shown that control is almost impossible. It is felt that it may be necessary to devise some way of ensuring that no one is permitted to have more dogs than can be effectively maintained and that any surplus are destroyed before they "go bush." It has been suggested that the registration fee should be increased, particularly for females. Special consideration could be given to those who use dogs in their occupations or are registered breeders.

General.

No doubt the most successful answer to our wild dog problem is the destruction of habitats and breeding places by the advance and intensification of settlement or regular attention by hunters. While there are places where wild dogs may mate and breed (and it must be remembered this includes domestic dogs running loose), the complete extermination presents many difficulties and the aim must be effective control. This will be achieved only by well organised and co-ordinated work by the Agriculture Protection Board, local authorities, farmers and pastoralists.



Write for Leaflet giving further details

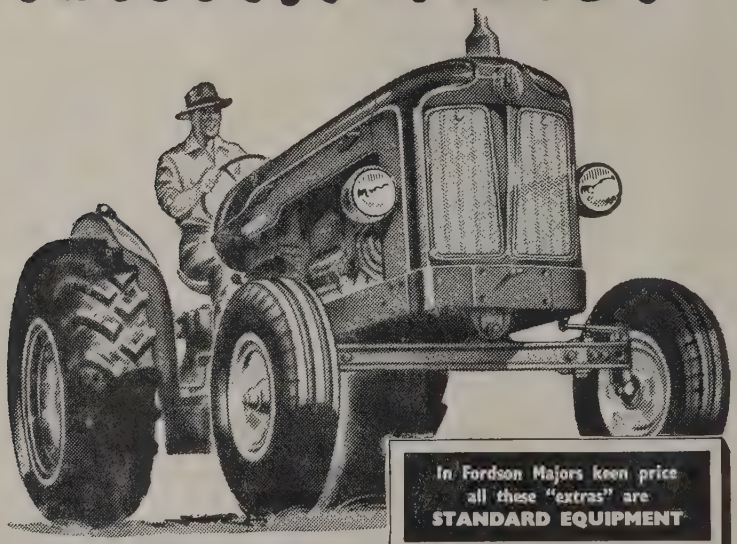
A. H. McDONALD & CO.
PTY. LTD.

Showrooms & Works:

566-574 BRIDGE ROAD,
RICHMOND, E.1., Victoria

38-42 MONGER STREET, PERTH
and at MELBOURNE, SYDNEY, BRISBANE & ADELAIDE

AUSTRALIA'S GREATEST TRACTOR VALUE!



More Farm-right features than any other tractor!

Latest overhead valve, low-friction engines with choice of kerosene or diesel power . . . 6-speed transmission . . . "touch-control" hydraulics . . . 3-point linkage . . . range of "Crown" and matched implements and equipment . . . and many more advances in working versatility and economy. Feature by feature, your Fordson Dealer will show you why Fordson Major is easily Australia's greatest tractor value.

FORD MOTOR COMPANY OF AUSTRALIA PTY. LTD.

In Fordson Majors keen price all these "extras" are STANDARD EQUIPMENT

- Power take-off
- 2-Speed Belt Pulley
- 12 Volt Starting Equipment
- Electric Lights
- Adjustable Track Front Axle
- Independent Turning Brakes
- Fully Adjustable Drawbar
- Tachometer
- "Yuba" Type Spark Arrestor
- Radiator Shutters and protective Chaff Screen
- Large weatherproof toolbox

KEROSENE MODEL with pneumatic tyres	DIESEL MODEL with pneumatic tyres
£918	£1077

Optional equipment—Hydraulic lift and 3-point linkage only £76

LATEST PRODUCT OF AUSTRALIA'S GREATEST NAME IN POWER FARMING

FORDSON MAJOR

FM40-27E

PAINT plays an important part in modern life. From the eyelets of your shoes to the vast bulk of a bulldozer, from an egg-whisk to the soaring facade of a skyscraper, there are millions of surfaces finished with paints or varnishes. There is hardly a country under the sun that does not contribute some pigment, dye, chemical, oil or spirit used in paint-making—an industry which has achieved tremendous importance throughout the world.

As preservatives that protect wood, metal, and many other materials from deterioration, paints and varnishes effect tremendous savings far outweighing their cost. The damaging effects of rust and corrosion, the ravages of insects and fungi, the deterioration caused by scorching suns and wet weather, may be minimised by keeping the surfaces painted with good materials.

Paint beautifies while it protects and thus makes a tremendous contribution to the pleasure of living. We are all sensitive to colour and are influenced—to a far greater extent than most of us realise—by the eye-appeal of the articles we use and the surroundings among which we live.

The farmer should know and understand paints and painting, for the wise use of paints and varnishes can enhance the appearance of his buildings and equipment and prolong their useful life. As the services of experienced painters are seldom available in country districts, it is hoped that these notes will provide the answers to some of the problems confronting the amateur.

THE COMPOSITION OF PAINT

An understanding of the ingredients which are blended to produce a modern general-service paint will help the amateur painter to obtain good results.

Paint consists of pigments to give the required colours, to give opacity or "hiding" properties and to combine with the liquid portions to produce a durable protective finish.

Fig. 1.—Cracking and scaling

The liquid constituents are designed to serve as a "vehicle" for the pigments and to carry the pigment particles in such a way that the mass is fluid until and during the process of application. After this, the liquids must be capable of hardening

and acting as a binder to hold the pigment intact on the surface which has been painted. The liquid gives "life" to the paint and if correctly blended will give an elastic vehicle capable of withstanding the vagaries of the atmosphere for long periods.

SOME COMMON PIGMENTS

White Lead is the oldest of the white pigments and has been used since the days of the Phoenicians. It is obtained by submitting metallic lead to the corrosive action of acetic acid. It has good obliterative powers when used in paint and does not crack. On the other hand it is not a good "spreader" and has a tendency to oxidise the oil with which it is ground. This renders white lead paint liable to "chalking." This is a disadvantage but has a saving grace, in that a "chalked" surface is more adaptable to repainting than one on which the paint has cracked.

Zinc Oxide is another white pigment that is softer and superior in colour to white lead. It is a combination of one atom of metallic zinc with one atom of oxygen. It is bulkier than white lead and requires more oil to grind it into paint. It is unaffected in colour by any gases present in the atmosphere, may be mixed with other pigments and is non-poisonous. It is liable to harden the paint film causing it to "crocodile," crack and peel, therefore repainting may be difficult and costly owing to the need for burning off the old paint.

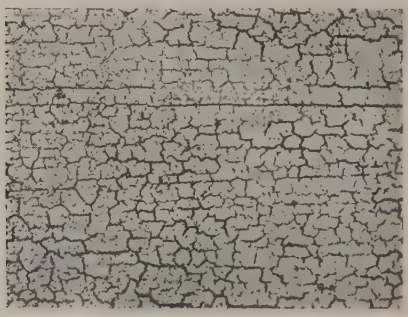


Fig. 2.—"Crocodiling" or "alligatoring"

Lithopone is a white pigment of good colour and soft texture. It has good opacity and is slightly less bulky than zinc oxide. It is a mixture of zinc sulphide and blanc fixe chemically combined in special furnaces. Lithopone is mainly used for interior flat wall paints.

Titanium Dioxide is made from a black sand called ilmenite found in various parts of the world and subjected to a complicated process of chemical reactions, washing and heating to high temperatures. It is the whitest of pigments, soft in texture with excellent opacity or hiding power. It is very widely used in modern paints since one of its faults—a tendency to "chalking"—has been overcome.

Fig. 3.—Blistering and Peeling

There are other white pigments which have their purposes in paint mixture, but the four mentioned are the most important. Reference has been made to the various deficiencies or faults of these pigments, and research by paint chemists has consequently determined the correct combination of these pigments to produce the ideal paint—a paint that will be durable, retain a gloss, will not crack or peel necessitating costly repainting, but will slowly weather by controlled chalking to a smooth film that is ready for repainting after four or five years.

Colour Pigments: A large number of colour pigments are employed in the production of the many shades in which modern paints are made. These pigments may be roughly classified into two groups—natural and artificial. The former includes all mineral and earth pigments such as ochres, siennas, oxides, umbers and many pigments which are not extensively used. Under the heading of artificial pigments are included chemical colours such as lead chromates, Prussian blues, lake colours, etc.

THE LIQUID CONSTITUENTS

Linseed Oil: This is a vegetable oil which has been found and proved by ages of actual use to possess more of the elements essential to making good oil paint than any other oil which has been tried. The oil is extracted from matured seed of the flax or linseed plant.

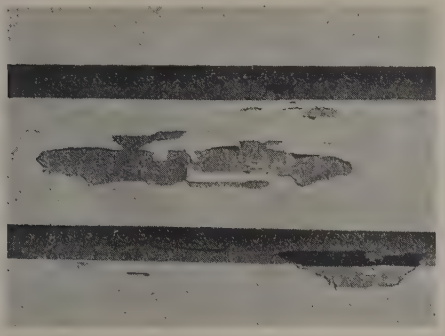


Fig. 4.—Peeling

Turpentine is a thinner, commonly known as Spirits of Turpentine. It is produced in various parts of the world, but a large proportion of the turpentine sold is taken from the sap of the long-leaf pine which is common in various parts of the southern states of the United States of America. Incisions are made in the trees and the sap which exudes is collected and put through a process of distillation which causes the thin fluid or turpentine to separate from the mass. A large proportion of the remaining part of the sap, after the turpentine has been distilled off, is vegetable acid in solid form which we know as resin. Turpentine is a splendid solvent, is almost completely volatile, has wonderful penetration and imparts free working of the paint or enamel under the brush.

During the last decade, petroleum refiners have advanced their techniques to such a degree that high-quality mineral turpentine is quite the equal of the original vegetable turpentine and is now widely used in paint manufacture.

Driers: For drying oil paints it has been found that the most satisfactory drier is made by cooking certain metallic drying salts, such as some forms of lead or manganese, in oil, until the oil has taken up the metallic salts. A drier is necessary in order that the paint may be dried sufficiently to withstand harmful influences within a comparatively short time. The drier, when added to paint, simply hastens the natural tendency of linseed oil to absorb oxygen from the air. When the oil takes up oxygen it becomes modified or transformed into a solid—and we say that the paint has dried.

CONCERNING VARNISH

Varnish consists of gum or resin melted in oil and then thinned with solvents so that the gum is held in solution When applied to any surface, the solvent evaporates and a smooth, lustrous film is left. This film may be purely decorative or it may contain both protective and decorative features.

Varnish may be roughly divided into two types—those which contain more oil than resin and those which contain more resin than oil. They are known as long-oil and short-oil varnishes respectively.

The long-oil varnishes are designed for work where an elastic, tough, long-wearing film is necessary. The spar varnish used on ships and small boats is a typical long-oil varnish able to withstand outside exposure, rain, wind, sun, salt spray, etc. It must be able to keep its gloss, not show white spots even after being constantly submerged, and must not chip easily or peel. Such long-oil varnishes dry more slowly than the short-oil types.

In recent years the old-type varnishes have been very largely superseded by synthetic products which are available in matt to full gloss finishes, and give excellent results.

The four main constituents of the oil varnishes are the oils themselves, resins, driers and thinners.

The oils impart flexibility, toughness, adhesion, durability and relative waterproofing qualities. The resins impart hardness, waterproofness and gloss. Hard resins accelerate drying. The driers have as their main function the acceleration of the drying time. The thinners have as a primary function, the reduction of viscosity or the increasing of fluidity so as to permit easy application of the varnish coating.

Linseed oil has been used in varnish manufacture since the fifteenth century and more linseed oil is used in varnish making than all other oils combined.

Tung or **Chinawood** oil ranks next to linseed oil in importance. It is quicker drying and faster bodying than linseed oil and has better resistance to water. Tung oil is used extensively in the quicker drying four-hour varnishes. Fish oils are used as drying oils and dehydrated castor oil is also a good partial substitute for tung oil and is being used in increasing quantities. The use of soya bean oil is also likely to increase in the paint industry as further research work is undertaken.

Resins are divided into two main groups —natural and synthetic. The natural resins of most importance in the varnish industry were dammar, kauri copal, congo copal, east india gum and shellac. Since the introduction of ester gum, the first synthetic resin of practical importance, in 1900 great strides have been made in varnishing making. With the use of synthetic resins a great advance was made as varnishes were improved in outside durability, toughness, gloss retention, colourless properties and water resistance.

Driers consist of certain metals such as lead, cobalt and manganese chemically combined in a compound that is oil-soluble and thus they are able to exercise their peculiar function of converting liquid drying oils to solid oxidised films which are tough, water-resisting and durable. This is achieved by accelerating the rate at which the oil absorbs oxygen from the atmosphere. Modern driers are so efficient in this respect that a very small addition to linseed oil produces a dry film in a matter of hours instead of days. Terebene is an example of this type of drier.

MIXING PAINTS

We have given a brief description of some of the ingredients of paints and varnishes. It is by no means a complete list, but it covers the substances in common use.

The preparation and blending of these substances in the proportions best designed to give smooth application, good covering qualities, beauty, durability and all the other attributes of a good paint, is a task for the experts.

In these days, even the large-scale users of paints seldom find it worth while to mix their own. They are content to leave it to the manufacturer who maintains staffs of skilled technicians and a factory operating on a high plane of mechanical efficiency with special machinery for grinding and blending.

The farmer therefore who wishes to carry out a painting job will be well advised to purchase ready-mixed paints bearing the brand of a reputable firm—and to use the paint according to the instructions issued by the manufacturer.

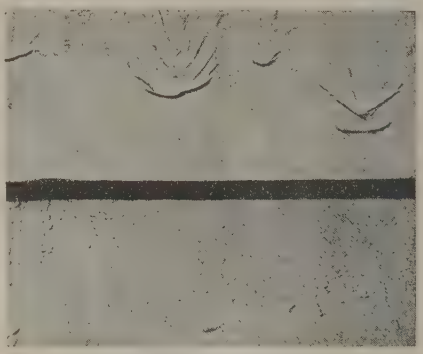


Fig. 5.—Running and Sagging

We live in an era of keen commercial competition and the manufacturer is jealous of the reputation of his products. He can be depended upon to use the best materials available and his recommendations for the use of the paint are designed to produce the most satisfactory results. A satisfied user is a potential customer for the future.

PAINT FAULTS

Before discussing the best methods of applying paint, let us take a glance at some common paint faults. An understanding of their causes may assist in avoiding such failures in the future.

Excessive "Chalking."—Obviously a paint cannot last forever. It must deteriorate in course of time, and gradual "chalking" is actually desirable and much to be preferred to flaking, cracking or peeling as the surface is left in a good condition for repainting.

Chalking is just what the name suggests —the surface of the film becomes chalky or powdery so that it rubs off leaving a matt surface. Briefly, chalking is caused by the oxidisation of the oil and if it occurs

gradually over a period of say four to five years it is an indication of a good quality paint.

Excessive chalking shortens the life of the paint film and leaves the material unprotected. It is caused very largely by faulty application.

One-coat painting is liable to chalk quickly as the paint film is thin and the weathered surface robs the paint of its binder. Too much oil added to the finishing coat promotes rapid chalking too, as the pigment particles are spread too far apart, permitting the sun to penetrate and break down the film.

Cracking and Scaling.—Cracking starts with fine, scarcely visible, breaks in the paint film. The cracks widen and the paint flakes off. There are several causes.

(a) The paint becomes brittle as it ages. As the wood or metal beneath it expands and contracts, the paint film cracks through lack of elasticity.

(b) The previous coats have become lifeless, with poor adhesion, so that the strong new coat pulls them loose on drying.

(c) Excessive quantities of zinc oxide will cause the paint film to harden and crack or "crocodile."

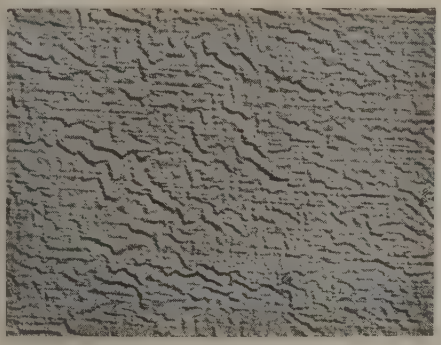


Fig. 6.—Wrinkling

Complete removal of the old paint by blowlamp, scraper or sandpaper is the only certain preventive of this trouble.

"Crocodiling" or "Alligatoring."—This is an extreme form of the cracking described above. The surface coat cracks into a bold pattern resembling that of a crocodile-skin. This fault is most marked when a hard, quick-drying paint is applied over a slow-drying or insufficiently-dried undercoat.

The use of an inferior undercoat made with slow-drying oils will cause crocodiling. Allow ample time for even a good undercoat to dry before applying another layer of paint.

Blistering.—Moisture behind the paint film causes blistering. Wet weather painting, the painting of green wood, and moisture seeping on to the wood from rain percolation or faulty plumbing are frequent causes of this trouble, which usually occurs when the paint film is new and very elastic. Windows and doors exposed to the weather are often insufficiently sealed by painting. Failure to paint the tops of doors and windows allows moisture to soak into the end grain of the wood. Shrunken putty in a window sash allows water to get into the wood, and leaky gutters and downpipes are other common sources of moisture in woodwork.

Running and Sagging.—This may be caused by using a paint with too much oil and applying it too thickly. Drying takes place too slowly and the paint sags. A sudden drop in temperature will delay drying and give the same effect.

Wrinkling.—A less extreme form of sagging, in which the paint forms a number of small surface wrinkles. Failure to brush out the paint to a thin even coat, the use of boiled linseed oil in house paint, too heavy a coat, and fog or frost on a newly-applied paint film are all common causes of wrinkling.

Loss of Gloss.—Premature or uneven loss of gloss is commonly caused by adding oil to the finishing coat of a ready-mixed paint. This practice slows down the drying and allows the paint to accumulate dust and dirt. It also lowers pigment concentration and causes early chalking because of penetration by the sun.

PREPARING THE SURFACE

For satisfactory painting, the surface to be covered must be dry, and free from grease, dust, smoke deposits, loose scaly paint from previous treatments, or any other material likely to interfere with the application, and subsequent retention by the surface, of a smooth even paint film.

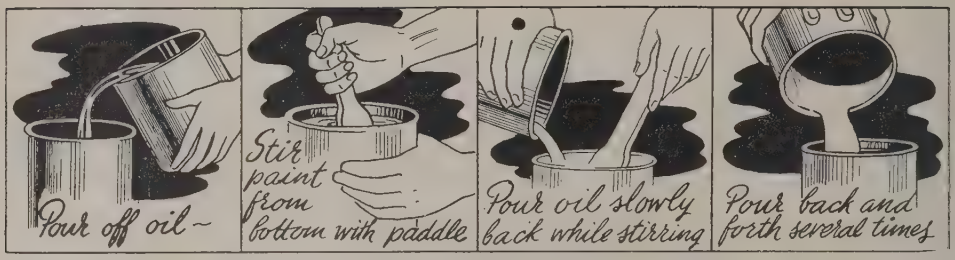


Fig. 7.—Preparing the paint

The use of a wire brush and scraper will assist in removing loose material; sandpaper may often be used to advantage, and a rub-down with a cloth dipped in turpentine or petrol may be necessary to remove grease.

Where a thick coat of cracked and hardened paint mars the surface, use a blowlamp and shave hook then rub down the surface with sandpaper.

Badly smoke-stained surfaces are often encountered in rooms where wood-burning stoves or badly constructed open fire-places are used. Before re-painting, such surfaces should be washed down with lime-water made by dissolving 6 oz. hydrated lime in a gallon of water.

Apply lavishly and allow to dry, then dust down thoroughly before painting. In the case of very persistent smoke-stains, the lime-water treatment may need to be repeated two or three times before the paint is applied.

PREPARING THE PAINT

When a tin of ready-mixed paint is opened, it will usually be found that the oil and other liquid constituents are on top with the heavier pigments deposited in lower portion of the container.

It is a good idea to pour off the liquid into a clean container, then mix the thick pigments thoroughly with a flat paddle until they form a smooth paste. Gradually add the liquid, stirring all the time, and finish by pouring the mixed paint from one clean container to another back and forth several times to complete the process.

Where the paint is to be thinned down by adding extra oil, turpentine or driers (according to the manufacturer's instructions) these are best stirred into the liquid before it is added to the thick pigment.

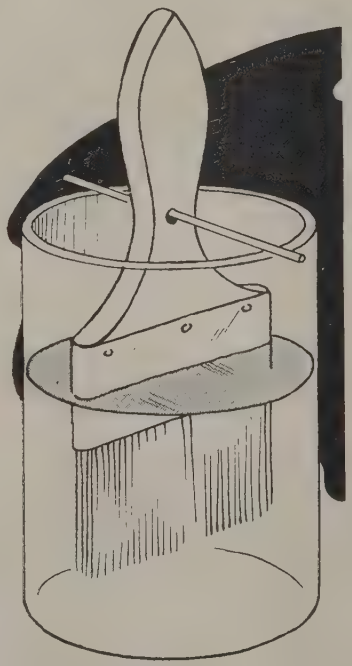


Fig. 8.—Immerse bristles in water when painting is suspended for a few hours

PRIMERS AND UNDERCOATS

Although many amateurs are content to use thinned-down ordinary paint for the primer or first coat, it is advisable to use the recommended primers and undercoats specially compounded by the manufacturers.

Various primers and undercoats are now available in ready-mixed form and it is no longer necessary to thin them down with oil or turpentine.

The primer is usually a full oil mixture which has marked penetrative powers, especially when used on bare wood.

Puttying.

After the primer has been applied, nail-holes, cracks and joints should be filled in with linseed oil putty. Do not apply putty to the bare wood. It adheres much better to a primed surface.

The primer fills in the pores of the "hungry" dry material and forms a bond for the succeeding coats.

The undercoat provides "body" and dries with a semi-flat surface which makes an ideal base for the finishing coats.

USE GOOD BRUSHES

The price of a good paintbrush in these days will give the average man a severe "pain in the pocket," but don't let this tempt you into buying the cheaper grades.

Buy a good brush and—as it represents a sizeable investment—take care of it.

Never let the paint dry on the brush. If you merely have to suspend painting operations for a few hours and wish to avoid washing the brush out with turpentine or other cleaners, immerse the bristles in water.

The best method of achieving this is to drill a hole through the handle of the brush, large enough to take a piece of stout wire about six inches long. Hang the brush in a tin or jar so that the wire rests on the rim and holds the bristles clear of the bottom of the vessel. Pour in sufficient cold water to cover the bristles and your brush will remain in good condition until needed again.

When ready to re-commence painting remove the wire and a few sharp flicks will shake off most of the water. A few strokes of the brush on a piece of waste wood will remove the remainder—and the brush is ready for work again.

When painting is concluded, wash the brush thoroughly in turpentine, petrol, kerosene or similar substances and then in warm soapy water until all traces of paint are removed. Allow to dry, and then wrap the brush in paper to exclude dust, and store in a dry place.

Old neglected brushes may often be reclaimed by treating with one of the proprietary cleaners sold by paint stores, but the conscientious worker will never let his brushes reach this stage.

USE LONG SWEEPING STROKES

In applying paint, hold the brush well up from the bristles in such a manner that the wrist and fingers can flex easily.

Do not dip the brush deeply into the paint—a third or less of the length of the bristles is sufficient. Surplus paint should then be removed by slapping the brush lightly against the inside of the container or drawing it in a wiping motion across the edge of the tin.

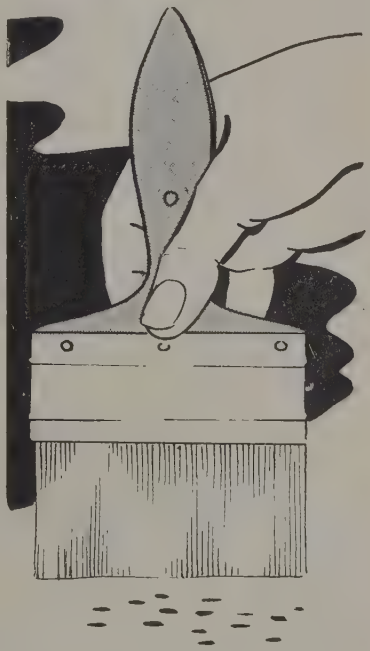


Fig. 9.—Hold the brush so that the wrist and fingers can flex easily

Apply the paint in long sweeping strokes and try to bring the brush lightly against the surface when commencing the strokes —increasing the pressure towards the centre and then lifting the brush gradually towards the end of the strokes.

Stir the paint at intervals as the pigments are liable to settle.

The Editor wishes to acknowledge with grateful thanks the assistance received from the technical staff of Lewis Berger & Sons Pty. Ltd., in the preparation of this article.

A GRAND NEW SMITHDRAULIC LOADER *WITH* AMAZING REACH

Exceptional 10ft. Lift
15cwt. Capacity

Powerful and obedient, this rugged new Smithdraulic can be quickly converted from loading to bulldozing, tree clearing and earth-moving. Extra equipment available—

BLADE
BUCKET
JIB CRANE
HAY SWEEP
FORKED TYNE BLADE

THE SMITHDRAULIC WITH SAW-TOOTH TREE PUSHER ON CHAMBERLAIN 45 KA TRACTOR

Boom removed from Tractor in less than 10 minutes. Any make of Tractor fitted. Transport arranged to inspect SMITHDRAULIC under actual working conditions

SMITHS
AGRICULTURAL IMPLEMENTS PTY. LTD.
8 GLOSTER ST. SUBIACO PHONE W3865

NOOGOORA BURR

[*Xanthium spinosum* L.]

Noogoora burr was first recorded in Western Australia in 1949 following upon the discovery of a number of the burrs in a used cornsack at Northam. The resulting publicity led to the discovery of plants in several localities where burrs had been introduced in parrot foods and in packing materials. In Queensland, this weed is responsible for heavy losses to the wool industry

WEEDS of Western Australia

By **G.R.W. MEADLY** M. Sc.
Officer in Charge, Weeds and Seeds Branch

NOOGOORA BURR

(Xanthium pungens Wallr)

IT is generally accepted that Noogoora burr was first introduced to Australia at Noogoora Station in Queensland in the early sixties of last century, presumably as an impurity in imported cotton seed. Southern Europe and Central Asia are regarded as being the natural habitat of this plant, but it now occurs in many other widely-separated countries. In North America and South Africa, members of the genus Xanthium are referred to as cockle-burr or clot-burr.

Noogoora burr has replaced prickly pear as the most serious weed problem in Queensland, infesting as it does enormous tracts of sheep country in that State and menacing the remainder. The magnitude of the problem can scarcely be appreciated without seeing the dense growth on what was previously rich grazing land. Every main watershed in Western Queensland is affected and the area is reported to be increasing each year.

Fig. 1.—A Noogoora burr plant found growing in a Nedlands garden

Noogoora burr is also a major pest in northern New South Wales but is more restricted in Victoria and has been recorded from only a few localities in South Australia and Tasmania. Although favoured by summer rains, the few occurrences indicate that it could assume pest proportions in the Southern States, especially in irrigation areas. It is significant that during a succession of relatively dry years in Queensland, Noogoora burr not only maintained its hold but continued to spread. It was first recorded in Western Australia in 1949. An employee of a Northam flour mill noticed some strange burrs attached to a sack and fortunately was sufficiently interested to forward them to

Fig. 2.—Close-up showing leaves and burrs

the Department of Agriculture for identification. These proved to be Noogoora burrs and a hurried visit to Northam disclosed that the sack contained more than 300 mature burrs. The markings showed that it had been used for several purposes including the transport of maize for stock food from Queensland to this State. Noogoora burr occurs profusely in many of the maize-growing districts and the presence of the burrs, therefore, was not difficult to explain.

Widespread publicity given to the discovery resulted in many reports of suspected plants and burrs. Fortunately in most cases other plants had been confused with Noogoora burr, but some very helpful information was obtained and plants were located at Nedlands, Harvey, Fremantle and Morley Park. Further burrs were found in an old sack wrapped around a box of butter sent to Bowgada and they were also detected in sunflower, maize and sorghums imported for parrot food. More recently a burr was submitted by a Dangin farmer who found it in straw packing around a stove purchased from a Perth store.

DESCRIPTION

Noogoora Station in Queensland, where the weed was first recorded in Australia, has provided the vernacular name.

Noogoora burr is a spreading annual attaining a height of six to eight feet, but sometimes flowering and seeding when less than a foot high. The young stems are mottled and the somewhat roughened leaves are shaped as shown in the illustration. They are three to six inches broad and have a stalk varying from one to five inches in length. The inconspicuous flowers are formed in clusters close to the stem. The fruits (burrs), half an inch or somewhat more in length are terminated by two erect or slightly curved beaks. The burrs are straw to brown in colour and each contains two flat seeds.

Noogoora burr is sometimes confused with the related Bathurst burr *(Xanthium spinosum)* but this is a smaller plant with more deeply lobed leaves and smaller burrs bearing hooked spines, but without the two beaks. It also has trifid spines at the base of the leaves.

SIGNIFICANCE

Although of some importance as a weed of summer crops such as maize, Noogoora burr is of most significance in sheep country. The dense growth smothers pasture species, seriously affecting the carrying capacity and at times preventing sheep from gaining access to watering places. A more tangible and very substantial loss is caused by the burrs becoming entangled in wool. They are of such a nature that they cannot be removed by the mechanical processes adopted, and carbonising with acid is necessary. A number of years ago it was stated that as much as 16% of the Queensland wool clip contained burrs, necessitating an expenditure of a quarter of a million pounds for treatment. The direct loss to wool growers at the present time would be considerably higher, without taking into account reduced pasture production and cost of control measures.

In cattle areas the losses are of a different nature as seedlings of Noogoora burr have caused many fatalities among cattle. In October 1929, eleven of a herd of 55 dairy cows died within a few days at Bundaberg and 42 head were lost on a farm at Goomeri. Deaths due to Noogoora burr poisoning have been recorded from many localities in Queensland and in September 1949, 112 cattle valued at £1,300 were lost in two days in the Gympie district.

Noogoora burr poisoning was studied by Seddon and King (1937) at the Veterinary Research Station, Glenfield, N.S.W. Their experiments showed that the plant is poisonous to pigs, sheep and cattle but only at the early growth stages when the seed-leaves or cotyledons are still present. The lethal doses indicated were 2% of the body weight for pigs with somewhat less for calves and a considerably greater amount for sheep. The poisonous principle appeared to be confined to the cotyledons and a lethal dose caused death in from 20-48 hours. Animals became excited with jerky movements and stilted gait. Details of symptoms and post-mortem examinations are described by Kenny, Everist and Sutherland (1950).

A glucoside has been isolated from a species of *Xanthium,* occurring in the seeds and young plants at the cotyledon stage. It is likely that Noogoora burr contains this type of toxin. Marsh (1924) states that some beneficial results followed the administration to affected animals of oils and fats such as linseed oil.

Noogoora burr is a primary noxious weed for the State

CONTROL

Being an annual, all control measures have as their objective the prevention of seed formation, the method depending on the extent and location of the weed. As yet, only odd plants have been found in this State and destruction by hoeing and burning has been possible. Sites where plants have seeded should be kept under observation for a number of years with a view to locating seedlings resulting from delayed germination. These usually appear following rains in the spring and summer.

Noogoora burr is susceptible to the 2, 4-D or hormone-like herbicides, small plants being killed by one pound of acid equivalent per acre. Some success has been obtained with power spraying in Queensland, but there are many practical difficulties when such extensive areas are involved. Besides the cost, labour is scarce and the movement of equipment is made difficult by steep banks and soft soils.

During the period 1935-1939 large numbers of the seed-fly (Euaresta aequalis) were introduced from the United States and liberated in various parts of Queensland, but the results were very disappointing as it showed no inclination to increase or spread. The possibilities of biological control are still being pursued, and such a method would be of inestimable value comparable in significance with *Cactoblastis* for the prickly pear.

As a time when only a few plants have been found in Western Australia, it is very interesting to recall the following statement concerning this weed made by Mr. J. H. Maiden when Government Botanist of New South Wales.—

"I was talking to Mr. F. M. Bailey, the Government Botanist of Queensland, a few days ago (this was written in 1896) about Noogoora burr. He said, 'I well remember when £50 would have stamped it out in my colony, now it would take untold wealth.'

"In 1899 I estimated that in New South Wales, £1,000 judiciously spent would entirely free us from the pest: without any desire to be sensational, I stated that, if allowed to spread unchecked, it would in

Fig. 3.—The burrs shown near the matchbox were found in the packing material on the left

Fig. 4.—Note the difference between the larger Noogoora burrs (on left) and the Bathurst burrs (on right). Apart from the disparity in size, the Noogoora burr has two projecting "horns" at the end

a few years deteriorate our territory to the value of a million of money. Today—this is probably not very wide of the mark."

Let us benefit from the costly experiences in other parts and prevent this weed from becoming established. There are many ways in which the burrs can be introduced. They have been found in maize imported for stock food and also in birdseed such as maize, sunflower and sorghum. Sheep have carried burrs in their wool and they have also been present in imported wool and hides. Other means of dispersal include used sacks and packing material as well as the mulch around garden shrubs. Careful inspections are being maintained to prevent introduction by these means and any plant suspected of being Noogoora burr should be reported to the Department of Agriculture

ACKNOWLEDGMENTS

H. R. Seddon and R.O.C. King (1937)—N.S.W. Department of Agriculture Veterinary Research Report No. 7.

G. C. Kenny, S. L. Everist and A. K. Sutherland (1950), Queensland Agricultural Journal, Vol. 70 part 3.

C. D. Marsh (1924), United States Department of Agriculture Bulletin 1245—Stock-Poisoning Plants of the Range.

BULL REGISTRATION

The Minister for Agriculture (Mr. E. K. Hoar) has drawn attention to the requirements of the Dairy Cattle Improvement Act, relative to the registration of bulls.

The Act provides that all bulls in the South-West Division of the State must be registered, with the exception of pedigree beef strain animals kept solely for beef production, which may be exempted on application to the Director of Agriculture.

Certified pure-bred bulls are registered on payment of a fee of 10s. for life, but grade bulls must be registered annually and a fee of 5s. paid with each application.

Registrations of grade bulls were due on January 1, 1955, and the Act stipulates that owners who have not complied with the regulations by January 21, are liable to a penalty not less than £20.

The Department should be notified immediately of the death or transfer of any registered bull.

WHEEL SLIP IN TRACTOR OPERATION

By F. R. STANLEY, Branch Tractor Sales Manager, Ford Motor Co. of Australia

HOW many farmers, when purchasing tractors, take the trouble to check up on the degree of wheel slippage that occurs when the tractor is under normal working conditions? I venture to say that the percentage who even inquire about wheel slippage will be particularly small, yet it is a very important factor in tractor operation.

Wheel slippage is the degree of tractional loss in a wheel over a measured distance and it is vitally important that this should be kept as low as possible otherwise too much horsepower will be lost before it reaches the drawbar and consequently the actual pulling power of the tractor will be much lower than would be expected for the size and power of the engine incorporated in the machine.

Slippage in wheeled tractors can vary from approximately 5% to 20% or even higher according to the working conditions, the size of the tractor tyres and the overall balance of the machine concerned. You will notice that some tractors have a very high wheel slippage ration and this may be due to the engine being so powerful that, despite the fitting of oversized or dual rear tyres and heavy wheel weights, the developed power is so high that the machine is unbalanced and excessive slippage occurs as a result of the wide gulf between the power of the engine and the weight of the machine.

Most tractor owners have heard of the Nebraska Test but probably very few know much about it or how it originated. The test originated in the State of Nebraska, U.S.A. in 1919, where it became a State law. In those days there was no fixed standard for the horsepower rating of tractors and some unscrupulous manufacturers built tractors and endowed them with fictitious horsepower ratings to boost the sales.

It was to counteract these practices that tests were conducted at the University of Nebraska to give a definite standard for comparison of performances of different makes of machines. Here in Australia similar tests have been carried out for many years by the Department of Supply and Development, Fishermans Bend, Victoria,* from whom booklets may be obtained free of charge, giving the results of current tests. These figures make interesting reading as they give not only the developed and rated horsepower figures for various types of tractors for belt and drawbar, fuel consumption but also the percentage of wheel slip, the importance of which has been mentioned above.

A "rule of thumb" method of calculating wheel slip percentages is to tie a piece of cloth on one of the spokes of the rear wheel and then to drive the tractor, unloaded, until the wheel has made exactly 30 revolutions. The distance which the tractor has travelled is marked and then the same course is covered with the tractor under load.

The number of revolutions to complete the course under load are carefully counted and the number of revolutions with the tractor made unloaded subtracted from the number of revolutions made under load. For instance the tractor under load may take 34 revolutions of the wheel to cover the same distance it covered in 30 revolutions with the wheel when unloaded. If we subtract 30 from 34 we have a wheel slippage of 4 revolutions in 34. To express this as a percentage we multiply the 4 by 100 and divide it by the number of revolutions made under load (34) and our answer is 11.8%.

* These tests are now being conducted at Werribee Research Station, Victoria, by the State Dept. of Agriculture.

HYDRAULICS REDUCE WHEEL SLIP

The tendency in modern agricultural engineering is to fit as many of the implements as possible directly to the tractor. These may be fitted in front, amidships or immediately behind the machine but in each case they are raised and lowered by hydraulics. The type most commonly used is some form of three-point linkage with the implements following immediately behind the rear wheels. This method is most popular because it tends to reduce wheel slippage to an absolute minimum. Because the implements are attached only a few inches behind the rear wheels of the tractor, they exert a downward drag on the wheels which minimises wheel slip and allows the tractor to travel in a higher gear than it would with a trailing type of implement of the same design In other words less horsepower is required to do the same job if we can eliminate the waste of power caused by wheel slip.

Quite apart from the saving in horsepower, the tractor-mounted implements are more convenient to handle, in that depth adjustment is usually by "finger-tip" control, the tractor and implements are more readily manoeuvrable and tractor-mounted implements practically eliminate headlands.

I have often been asked why it is that a crawler tractor which naturally has a much lower slippage percentage than a wheeled tractor, will have a drawbar horsepower rating which is lower than that in a wheeled tractor with a similar engine of equal horsepower The reason for this is that, due to the many driving parts of the crawler, there are frictional losses which result in a lower drawbar horsepower. However, due to the much lower percentage of wheel slip, the crawler will often pull more than its wheeled counterpart under similar conditions

Thanks to . . .

K. F. M.

CONCENTRATED D.D.T. EMULSION

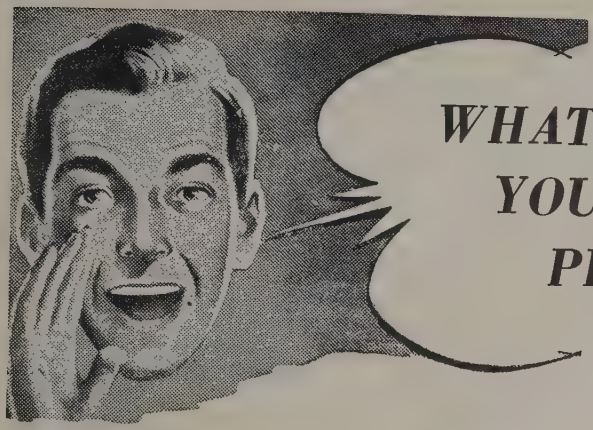
Flies resting on a K.F.M. treated area absorb sufficient D.D.T. through the pads of their feet in a few seconds to ensure certain death. One gallon of K.F.M. emulsion makes six gallons of working mixture.

1 Gallon MAKES SIX

FROM YOUR LOCAL AGENT or

WILCOX MOFFLIN LTD.

SOUTH TERRACE - FREMANTLE



WHAT'S YOUR PROBLEM?

DAVID GRAY'S

TECHNICAL
Information
SERVICE
Can Help You

Farmers, what's that you have on your mind? Some matter that's cropped up on Weed Eradication, Sheep Husbandry, Insect and Vermin control, or perhaps an Agricultural problem . . . . here's how to deal with it. Enlist the help of David Gray's Technical Information Service . . . . which welcomes any query at all on the Farm, Station, Orchard and Garden

Our scientific knowledge will greatly assist you to save money and also much needless work and worry

WE INVITE YOU TO WRITE . . . PHONE . . . OR CALL

DAVID GRAY & CO., LIMITED

10 RAILWAY PARADE, WEST PERTH ———— Telephone BA 2266

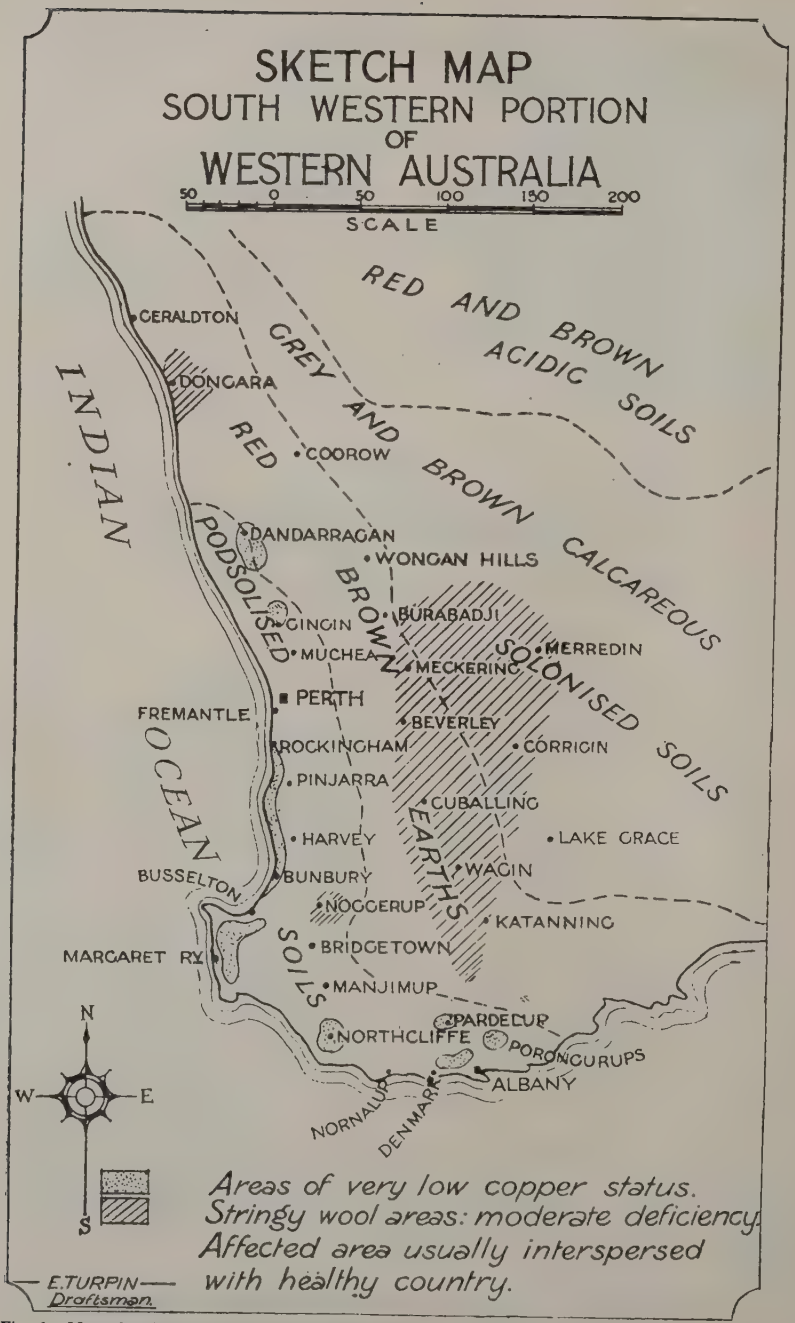


Fig. 1.—Map showing main copper-deficient areas in the South-West of Western Australia.

COPPER AND COBALT DEFICIENCY OF LIVESTOCK IN WESTERN AUSTRALIA

By H. W. BENNETTS, Principal, Animal Health and Nutrition Laboratories

PART 1.—DISTRIBUTION AND EFFECTS

DISEASES of animals due to copper and cobalt deficiencies are well known in this State where much of the original work, on the cause of these conditions, was carried out. These investigations have been recorded elsewhere and described briefly in this Journal by Filmer and Underwood (1936), Bennetts (1935), (1937), (1940), (1941), (1942) and Bennetts et. al. (1939), (1942). During more recent years the distribution of these deficiencies in Western Australia has been surveyed in some detail. This survey has been made by field investigations and by chemical estimations of animal tissues and pastures from many localities throughout the State.

With present knowledge it is now practicable to make standard recommendations for the control of these diseases and to indicate more clearly the regions and types of country where they may be expected to occur.

Animals may suffer from a deficiency of either copper or cobalt, or from a dual deficiency, as in "coast disease." Sheep and cattle are the stock mainly affected. Cobalt deficiency affects the ruminant animal only, but copper deficiency may affect horses and pigs as well as sheep and cattle.

In brief, the main sign of cobalt deficiency is a progressive wasting and weakness suggestive of starvation. The signs of copper deficiency vary with the species of animal affected and with the degree of the deficiency. In cattle the growth of young animals is retarded and they appear unthrifty; there may be fading of hair colour, intermittent scouring and lowered production and fertility. If the deficiency is very severe, cows, particularly those in production, may die suddenly from heart failure ("falling disease"). In sheep the occurrence of "stringy" or "steely" wool is the main characteristic in the adult, and lambs may develop a condition known as ataxia, under conditions of more severe deficiency. Young pigs also may show ataxia. Adult horses appear to thrive on copper deficient pastures, but foals bred on the same deficient areas show abnormalities in the structure and posture of the legs.

Sheep or cattle affected with "coast disease" may die from the effects of cobalt deficiency before they develop definite signs of copper deficiency.

A.—COPPER DEFICIENCY

The animal body requires small amounts of copper for various functions and if adequate amounts are not available the signs of illness, briefly outlined above, may develop. The deficiency may result from an unduly low copper content in the feed available to the animal or, sometimes, from the operation of factors which prevent the animal body from utilizing the adequate, or even high, amounts of copper contained in the diet. The nature and mode of action of these factors causing a "conditioned" copper deficiency are being studied both here and elsewhere.

Fortunately in this State copper deficiency diseases seem to occur, almost exclusively, on pastures which are low in copper content. Their detection and control are, in consequence, relatively simple. The results of surveys reported by Beck (1941), (1951) indicate that where the copper content of pasture is above 6 parts per million stock remain healthy, that with lower values between 3 to 6 p.p.m. signs of copper deficiency may be anticipated, and

that with values below 3 p.p.m. severe manifestations (ataxia and "falling disease") are present. The copper content of pastures on which "falling disease" was common was extremely low, usually below 2 p.p.m.

Regions and Types of Country Where Copper Deficiency Occurs in Animals.

The evidence available indicates that much of the western and southern coastal country is deficient. Evidence of deficiency has been observed from Broome in the north to as far east as Hopetoun, on the southern coast. Knowledge of the copper status of animals and herbage in the northern interior, however, is limited. On the other hand the distribution of the main affected regions in the South-Western Division of the State has been mapped (see map).

The regions where a more or less severe deficiency is almost universally present are:—

(a) Coastal and semi-coastal country. This includes the calcareous windblown sands of the coastal fringe, which are invariably deficient in copper (and in cobalt) and the "light" country of the coastal plain which is deficient to a variable degree. The latter includes the banksia and tuart sands, the peaty swamps and much of the country adjacent to Albany.

(b) The Gingin and Dandarragan districts (cretaceous country).

(c) The Busselton-Margaret River and Northcliffe districts where a widespread and very severe deficiency exists, particularly throughout the jarrah-redgum belt. Similar country west of Mt. Barker is also markedly deficient. In other types of forest country in the lower South-West, notably in the Denmark, Walpole, Manjimup and Pemberton districts, the deficiency is less severe and more patchy in distribution.

In the agricultural areas further inland especially in the Great Southern district and the wheatbelt the occurrences of copper deficiency in animals is still more widely scattered, less severe, and more subject to seasonal variations. In these areas, which have been mapped in conjunction with surveys of woolclips initiated in 1941, the manifestations are restricted to seasonal occurrences of "stringy" wool and occasional cases of ataxia in lambs. In some localities only occasional properties are affected, in others, as in the vicinity of Corrigin, the deficiency is more widespread.

Investigations in the region, referred to, have indicated that the types of country likely to be affected are light sandy (or sandy-gravelly) soils carrying predominantly whitegum, tammar and wodgil; or whitegum, associated with stunted jam and sheoak, although these vegetation associations do not necessarily indicate copper deficiency. It appears quite evident, however, that heavier forest country carrying salmon gum or york gum is generally healthy and that where sheep have adequate access to this, as well as to the lighter types, they are able to obtain sufficient supplies of copper for all bodily needs.

The whitegum, redgum, flooded gum, country of the "clover belt," notably to the west of the Great Southern railway is, almost generally, free from evidence of copper deficiency signs in animals, although some light sandy soil types in this region have been shown to be copper deficient. Here, as elsewhere in the agricultural areas, there may be evidences of copper deficiency if sheep are maintained on areas which are dominantly of the "light" sandy copper-deficient type (e.g. casuarina sands).

Seasonal Variation.

In the more severely deficient regions animals show evidence of copper deficiency every year, although even here the signs are more apparent during the green feed period than the dry, and in seasons favouring the growth of lush green feed than in drier years.

In the marginally deficient areas signs of deficiency may be slight or absent in some years and definite in others depending on the seasonal influences referred to.

Symptoms of Copper Deficiency in Cattle.

1. *Non-fatal Copper Deficiency.*

Calves may show signs of deficiency at an early age. Growth is retarded and there

is marked unthriftiness. The limbs show abnormalities—pasterns are straight and calves tend to stand up on the toes. Joints, particularly those of the hind legs, are "knobby" as a result of bony prominences. These clear up as the animal reaches the age of 1½-2 years. Diarrhoea and signs of anaemia are commonly noted. With increasing age the animals grow slowly and have a very stunted, undeveloped and unthrifty appearance. On some holdings they cannot be reared into profitable animals and are destroyed. Maximum size is not attained in adults on the worst-affected properties and each successive generation tends to be smaller in frame.

In adult cattle, manifestations are particularly marked during the period from August to October when, despite abundance of green feed, there is some loss of condition and the coat is very rough and "starey." A severe anaemia, due to copper deficiency, is commonly present during this period; recovery from this is rapid and spontaneous during the summer months.

Depraved appetite is common; cattle eat soil around the roots and butts of upturned trees. Scouring is frequently present. Temporary infertility with suppression of heat is an associated condition; many cows served during the autumn and winter months, although failing to get in calf, do not return to the bull generally until November or December when they are readily stocked. It should be borne in mind however, that temporary infertility may be due to a number of causes other than mineral deficiency. At the same time there is no doubt that the use of copper supplements did facilitate the stocking of dairy and beef cattle in the regions where copper was very deficient.

2. *Fatal Cases of Copper Deficiency—"Falling Disease."*

As reported previously "falling disease" occurs only in areas which are severely deficient in copper. Cattle only are affected, not horses, sheep or pigs.

Cows die, generally, when from four to seven years of age but not uncommonly when older. "Falling disease" is uncommon in younger animals and it not known to affect cattle under 15 months old. Male animals are rarely affected. Reports indicate that death occurs most frequently just before or within a week or two after calving. It is most frequently observed

Fig. 2.—A heifer suffering from cobalt deficiency.

Fig. 3.—The same heifer showing the improvement in condition following upon cobalt supplementation.

when cows are being brought into be milked, are standing in the bail, or are being driven out to paddock again. In some cases the cows have actually fallen on the milker. Deaths also occur when cows are at pasture but are rarely observed. A cow, apparently normal in health, suddenly bellows, throws up its head and falls dead. Death frequently appears to be instantaneous. Sometimes the animal falls and struggles feebly on its side on the ground for a period varying from a few seconds to five minutes. In these cases of longer duration intermittent bellowing, running movement of the legs, and attempts to regain an erect posture are also noticed. Finally the animal lies stretched out with head back and dies.

The following is a settler's account of a death witnessed by him:—

> "When I first started bringing the cows home she was perfectly normal and grazing with the rest. I had got them about halfway home when she stopped and started swaying on her feet; she seemed to be paralysed and could not move, she also seemed to be forcing water from herself. She then started to stagger with her head down, as if she was drunk, after that she fell flat on her side and rolled completely over with her back downhill, her legs and neck stretched out straight and her legs quivering. She gave a few groans, her back legs doubled up and she turned partly over on her back, her legs then went straight again and she was dead. She died within one minute and a half of when she started to sway."

Rarely an animal may show symptoms for 24 hours or more, intermittently pivoting with the head down, before dying suddenly in the typical manner.

The sudden death in "falling disease" is attributed to heart failure and extensive investigations have shown that it is associated with marked changes in that organ; cattle maintained on **severely copper deficient** pastures show a progressive destruction (atrophy and fibrosis) of heart muscle. This manifestation does not appear to occur in any other species of animal and has rarely been reported from outside this State. Prior to 1938, when the cause was determined, "falling disease" was a

source of serious economic loss in the Busselton-Margaret River region and at Northcliffe—similar mortalities were also reported from some coastal areas. Following the widespread use of copper fertilisers and supplements, however, the disease has ceased to occur and "falling disease" is now only of historic and scientific interest.

Symptoms of Copper Deficiency in Sheep.

In the adult sheep the main sign of copper deficiency is "stringy wool." Anaemia and scouring may also occur under some conditions.

"straight steely" wool, are loss of crimp and straight, glassy or silky appearance; the fleece lacks "bulkiness." The defect is much more noticeable in Merino than British breed types.

Banding of the fleece in black sheep, so that the staple shows alternate bands of pigmented and unpigmented wool, is also an early and characteristic sign.

The anaemia and excessive scouring, associated with a fairly severe degree of copper deficiency, occur particularly in the breeding ewes and are noted, generally, only during the winter months. Obviously both anaemia and scouring may be

Fig. 4.—"Stringy wool" from West Mt. Barker is shown on the left. On the right is normal wool from a copper top-dressed location at Dandarragan.

"Stringy wool" occurs even when pastures are deficient to such a mild degree that all other signs are indefinite or absent. In fact the absence of this wool defect in a clip, predominantly of the Merino type, can be taken as reliable evidence that stock are receiving adequate copper from the pastures provided, of course, that copper is not being supplied through bluestone worm drenches, etc.

The characteristics of "stringy wool," sometimes referred to also as "slippery" or

due to many other causes; the occurrence of these manifestations therefore has no diagnostic significance.

Lambs, born of mothers maintained on copper deficient locations, may show a disease, named ataxia. This name refers to the characteristic manifestation, an incoordination of gait.

This disease, resulting from a low copper status, affects lambs from birth to when about four months old. Typically there is some check in growth followed by a loss

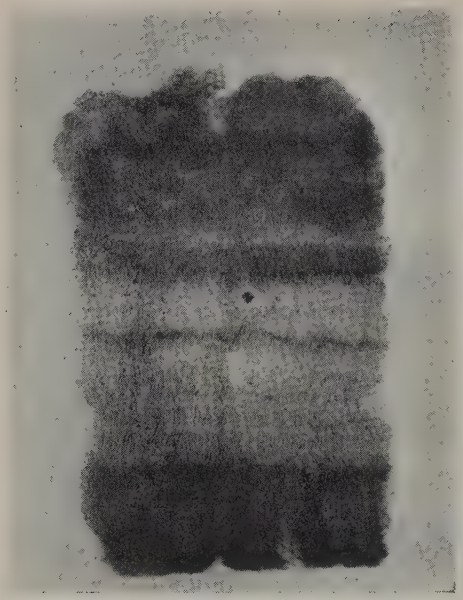


Fig. 5.—Banded black wool from South Australia. Photo by courtesy of Prof. E. J. Underwood.

of control of the hind legs. This, at first, is noted during driving, when movement becomes progressively more difficult. Finally the hind quarters sway ("sway back") and the affected lamb falls over and is only able to proceed again after resting. The condition gets progressively worse until in the course of days or weeks the lamb can travel only short distances or not at all.

The characteristic incoordinated gait (ataxia) results from degeneration of the nervous system and should not be confused with the stiffness and lameness seen in arthritis, an infectious disease.

More rarely copper deficient lambs are born dead, or are affected at birth or when a few days old with a rapidly fatal disease in which there are signs of brain involvement. In general the earlier the lamb is affected the more rapid and fatal is the course of the disease. Usually, under Western Australian conditions, lambs do not show signs until about four to eight weeks old; these may survive for weeks and, although the majority may die, others may grow to maturity. Some abnormality of gait, however, almost always persists.

The numbers of lambs affected and the course taken by the disease is related to the degree of copper deficiency and may vary considerably from year to year, particularly in areas not severely deficient. It has been shown quite definitely that a degree of deficiency insufficient to cause ataxia may, however, retard the growth and development of lambs to quite a marked extent.

Fig. 6.—A lamb suffering from ataxia, resulting from a low copper status (Mt. Barker).

Copper Deficiency in Horses and Pigs.

No detailed investigations have been made of the conditions affecting foals and young pigs, which are attributed to copper deficiency. There seems to be no doubt, however, that the abnormalities referred to do result from this deficiency and are prevented by copper supplementation.

Foals.—The so-called "rickets" which was formerly commonly seen, particularly in thoroughbreds, in the Gingin and Dandaragan districts, was characterised by unthriftiness, depressed growth rate and in the more severe cases, by pronounced stiffness of the limbs which were commonly held in various abnormal positions due to bending at the joints. The bones themselves did not bend as in true rickets (rachitis), but the development of bony enlargements, ("apple joints") was a not uncommon sequel. Affected animals tended to stand up on their toes. This condition was sometimes apparent at birth, or be-

came manifest during the succeeding six months. It did not develop after weaning, although animals tended to grow slowly until about two years old.

The disease was sometimes fatal, but stockowners found that its progress could be arrested by stable feeding mother and foal with **dry feed,** grown locally.

Young pigs, bred in the severely copper deficient area of the lower South West, commonly showed a condition of ataxia similar to that described for lambs—this condition is now rarely seen.

Post Mortem Appearances.

The carcases of animals affected with copper deficiency do not show any striking or characteristic appearance on post mortem examination. In lambs, however, the skeleton may be rather poorly developed—the shafts of long bones are thin and brittle and there may be spontaneous fractures of the ribs.

The microscopic examination of tissues however, may reveal marked changes, notably degeneration of the nervous system (demyelination) in lambs and pigs; this degeneration accounts for the characteristic incoordination of gait. No such changes have been seen in cattle, which do not show ataxia. Cattle, as we have indicated, may show marked heart abnormalities with loss of muscle and its replacement by scar tissue (atrophy and fibrosis). Some evidence of fibrosis may be obvious to the naked eye but generally microscopic examination is necessary to detect changes which, however, may be profound.

Control.

As a deficiency of cobalt, not uncommonly, occurs concurrently with that of copper it is convenient to consider the control of both together in a separate section at the end of this article.

B.—COBALT DEFICIENCY

Investigations carried out in this State, in South Australia, and more recently in other parts of the world, have demonstrated that minute amounts of the element cobalt are necessary for the growth and health of the ruminant animal. If the diet contains less than the exceedingly small minimal requirement, sheep and cattle will not thrive and may waste and die. Horses and other non-ruminant animals, however, do well on cobalt deficient pastures which will not maintain sheep and cattle.

As cobalt is not needed by plants we may have the anomalous spectacle of these animals dying, apparently from starvation, although grazed on luxuriant pastures. This was the case at Denmark until Filmer and Underwood *(loc. cit.)* determined the cause of "Denmark wasting disease."

Recent investigations indicate that the ruminant animal needs cobalt because this element is used by the microscopic organisms (rumen flora) which live in the paunch, and there build up certain nutrients (notably Vitamin B12) which are vital to the welfare of these animals. For this purpose the animal must **eat** regular supplies of cobalt. Any reserves which are stored in the liver are valueless for the purpose; injected cobalt is ineffective. As reported by Lee (1951) sheep receiving by the mouth 7 milligrams of cobalt once a week remained in excellent health; sheep receiving 21 mg. once every three weeks were not so thrifty, whereas others receiving 35 mg. once every four weeks developed typical signs of deficiency and some died.

Cobalt deficiency was responsible for serious mortalities of dairy cattle in the Denmark district, particularly following the establishment of group settlements in that area after World War I; it has also been responsible for the death of large numbers of sheep and cattle from "coast disease" which has been known since the earliest days of settlement of the State.

It is now recognised, however, that the distribution of cobalt-deficient areas is more extensive and that there are regions where the degree of deficiency is less severe and frequently does not lead to death, but merely to suboptimal growth and production. The occurrence of this marginal deficiency is not always easy to confirm. The estimation of the cobalt content of the liver does give some indication of the amounts available in the diet, but the test has limitations. In cases of marginal deficiency it must be interpreted in conjunction with other criteria, notably the symptoms shown, the region and type of country, or the demonstration of the animals' re-

sponse to cobalt supplementation; this is extraordinarily dramatic where a significant deficiency exists.

Survey work in relation to these considerations has been carried out in the South Western districts, since 1938, and has given a reasonably sound basis for general recommendations for the use of cobalt supplements in the South West Division of the State.

The Signs of Cobalt Deficiency in Animals.

The signs of cobalt deficiency exhibited by sheep and cattle are essentially similar. Young growing animals are more susceptible than adults. Where the degree of deficiency is only slight, that is in "marginal" areas, the signs may be rather indefinite, these being restricted to suboptimal growth and development in young animals. This may be more apparent in some seasons than others.

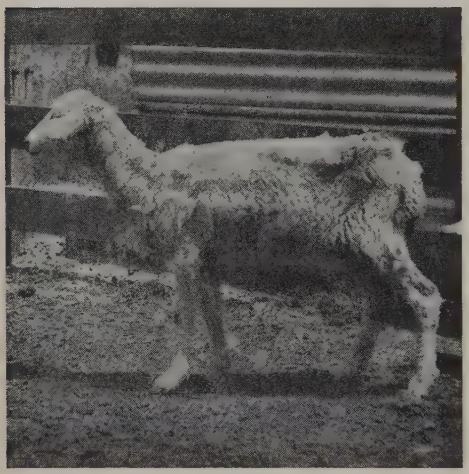


Fig. 7.—A sheep showing typical cobalt deficiency symptoms (Mt. Manypeaks).

Where a marked deficiency occurs there is a more or less rapid loss of condition and weakness, resulting from decreasing appetite. The animals literally starve themselves to death. In cattle there is a depraved appetite for rubbish such as bark, sticks, bones, earth, etc. and the coat becomes long and rough. In young calves, scouring is often noted. In cows, lactation is suppressed, abortion may occur, and stocking may be difficult. Wasting in cows is often particularly rapid immediately after calving or abortion.

In affected animals anaemia is pronounced in later stages of the disease. In sheep "weepy" eyes are notable and wool growth is depressed; in the later stages there is a definite break in the staple and the wool pulls out easily. Both cattle and sheep become weaker, and if not treated may die within two or three months or so after symptoms are first noted. The disease runs a much more rapid course in sheep and calves than in older cattle. It may occur at any time of the year, but is more common during the spring and early summer when green feed is abundant.

Many diseases, for example starvation, worm infestation, tuberculosis, etc., may cause similar signs to these outlined above. The following may be of assistance in determining whether a disease characterised by loss of condition and weakness is due to cobalt deficiency:—

1. The deficiency disease occurs in the presence of ample feed of apparently good quality, and is most common when the herbage is green.
2. Horses are never affected, whereas sheep and cattle are.
3. Young cattle, especially those between six and eighteen months are more susceptible than adults.
4. Sheep, and lambs especially, are even more susceptible than young cattle.
5. The response to cobalt supplementation or to a change to "sound" country is dramatic—affected animals regain their appetites almost immediately and within a day or two become obviously "brighter" and stronger.

The Distribution of Cobalt Deficiency.

On the evidence available it appears that cobalt deficiency is almost entirely restricted to the more coastal areas.

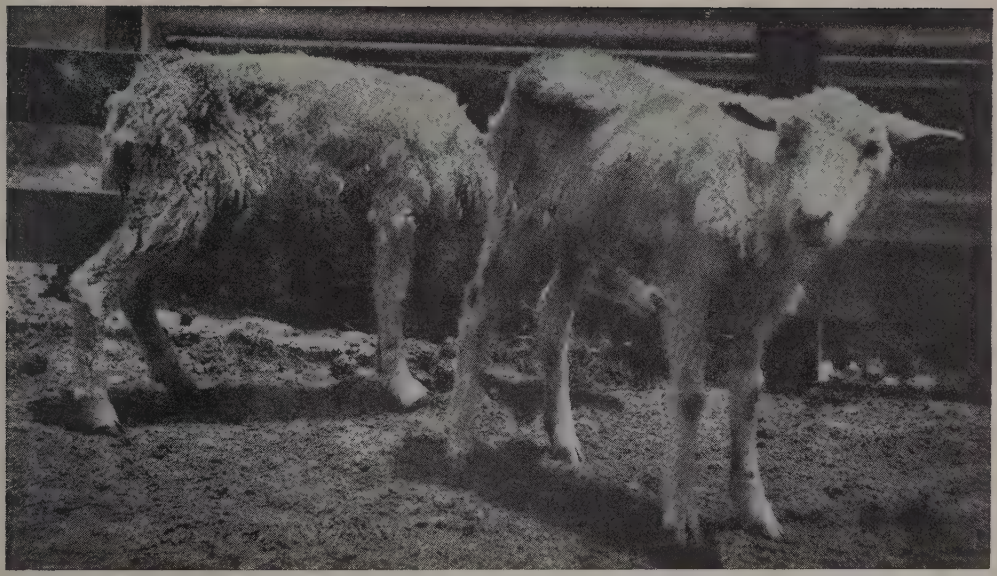


Fig. 8.—Cobalt deficient sheep at Mt. Manypeaks.

1. The severely affected areas, where it is, in general, impossible to maintain stock without the use of cobalt supplements are the following:—

(a) The Denmark region—the karri soils of the South-West, despite their rich appearance and loamy texture, are notably deficient.

(b) The "calcareous littoral"—the fine calcareous sands and limestone of the coastal fringe, throughout, are constantly deficient in cobalt (as in copper *q.v.*).

2. Cobalt deficiency is more patchy in distribution and more variable in degree in the following areas and types of country:—

(a) The banksia, tuart and jarrah sands appear to be fairly generally deficient and stock maintained on these types of country commonly show marked signs of deficiency e.g. at Muchea, in the vicinity of Perth, at West Murray and around Bunbury (copper deficiency is also present).

(b) Plain country adjacent to the South coast notably in the vicinity of Albany may be more or less severely deficient.

(c) The jarrah-redgum sands and gravels. Varying degrees of cobalt deficiency, from indefinite to fatal, have been found to occur on this type of country from in the vicinity of Busselton to Karridale, but the distribution appears to be patchy. (This is the region which is so severely deficient in copper—"the falling disease region").

It seems evident that jarrah-redgum country within 15 miles or so of the coast should be regarded with suspicion; similar country further inland, however, has only rarely been found to be cobalt deficient.

It is most probable that intrusions of alluvial soils, as for example at Capel, would prevent the occurrence of cobalt deficiency on properties consisting otherwise of the above types of country.

Cobalt supplementation is essential for sheep and cattle which are maintained on types 1 (a) and (b); is a fairly general necessity on types 2 (a) and (b); its use

may be advantageous on many locations on type 2 (c) where a marginal degree of cobalt deficiency appears to be widespread.

The methods of supplementation will be discussed in a separate section at the end of this article.

C.—"COAST DISEASE" A DUAL DEFICIENCY OF COPPER AND COBALT

From the earliest days of settlement it has been known that sheep and cattle could not be run continuously on much of the coastal country; generally within a few months they developed coast disease. It has been a common practice to graze large coast runs during the autumn and early winter months with stock, particularly cattle, which have been depastured further inland on "sound" country during the rest of the year. Sheep and cattle did very well for a short period on the natural herbage on the coast, but if left too long droving was frequently difficult on account of a "tail" which became too weak to travel. If left still longer animals died from coast disease. It was noted, however, that even badly affected stock recovered rapidly when they reached the "clay" country further inland.

Investigations carried out in South Australia by Marston *et. al.* (1938) demonstrated that coast disease was a manifestation of a dual deficiency of cobalt and copper. It was subsequently confirmed that coast disease in this State was an identical condition due to the same cause.

The manifestations of coast disease in sheep and cattle, generally, are essentially those of cobalt deficiency, namely progressive wasting and weakness associated with loss of appetite. If the animals live long enough and the liver stores of copper are depleted, sheep show "stringy wool" and ewes may give birth to ataxic lambs; in rare instances sudden deaths in cattle, simulating "falling disease" have been reported from coast runs. These deaths presumably resulted from the effects of severe copper deficiency but there has been no opportunity of confirming this. These mortalities have been reported only in cattle changed to the coast from the severely copper-deficient country at Gingin and Dandaragan—such losses have not occurred since the use of copper supplementation has been general there, and since cattle have been fed both copper and cobalt on coast runs.

As we have indicated the dual deficiency of copper and cobalt is not restricted to the calcareous sands of the coastal fringes but "coast disease" may occur somewhat further inland.

Fig. 9.—These sheep are suffering from "coast disease." The animal in the foreground is showing improvement after being treated with copper and cobalt.

PART 2.—THE CONTROL OF COPPER AND COBALT DEFICIENCIES IN ANIMALS

The manifestations of copper and cobalt deficiency can be prevented by the administration of appropriate mineral supplements given singly, or together where a dual deficiency exists.

The choice of the means of supplementation to be adopted will depend upon environment, methods of stock management, and upon economic considerations.

It must be borne in mind also that cobalt is needed by sheep and cattle at frequent intervals, preferably daily. Large doses may result in increased liver storage but such stored cobalt is of no value to the animal. On the other hand copper which has been stored in the liver is available to the animals so that they may still thrive even when this element is given at more infrequent intervals. A regular intake of both copper and cobalt, however, will give the best results.

The copper and cobalt content of pastures, grown in deficient areas, can be raised to normal levels by topdressing with appropriate compounds incorporated with the superphosphate fertilizer. This is certainly the method of choice if practical and economic considerations warrant its adoption; all grazing animals are then assured an adequate and regular intake of their mineral requirement.

Under many circumstances, however, it is necessary or desirable to use other methods of supplementation:—

(a) By the use of licks.
(b) By the addition of solutions or mixtures of minerals to the food.
(c) By drenching with solutions.
(d) By administration in the drinking water.

THE AMOUNTS OF COPPER AND COBALT REQUIRED BY ANIMALS

1. COPPER.

Sheep require a total daily intake of about 10 milligrams of copper. As the amount consumed, each day, from deficient pastures will be of the order 2-5 mg. it is recommended that a daily supplement of 8 mg. be given. This amount is equivalent, approximately, to only one forty thousandth of an ounce. **Eight ounces of copper sulphate will provide the requirement for 1,000 sheep for one week.**

Cattle need about 10 times the sheep dose so that 8 ounces of copper sulphate will provide an adequate supplement for 100 head for one week.

Pigs and Horses. There is no definite information of the requirements of these animals, but we have recommended that pigs receive the same amounts as sheep. If brood mares and foals are maintained on topdressed pastures the latter do not, in our experience, show the signs attributed to copper deficiency.

Copper is a poison and must be used with caution. Sheep, in particular, are susceptible to copper poisoning; they may accumulate dangerous amounts in the liver if given an intake higher than that recommended, or if copper storage by the animal is facilitated by other factors which cannot be considered here.

In a number of instances, in this State, serious mortalities have been experienced where sheep were run on copper topdressed country and were at the same time given free access to salts containing copper. **Only one method of supplementation should be used at the one time for sheep.**

2. COBALT.

The daily requirement of cobalt, for sheep and cattle, is very much lower than the copper requirement. The minimum requirement of sheep is exceedingly minute, approximately one-tenth of a milligram (equivalent to approximately one three hundred thousandth of an ounce).

It is recommended, however, that when pastures are deficient, sheep should receive a supplement of 1 mg. daily and cattle 10 mg. daily. On that basis **one ounce of cobalt sulphate or cobalt chloride will provide an adequate supplement for at least 1,000 sheep, or for 100 cattle for one week.**

Cobalt, unlike copper, is not very poisonous and the doses recommended, although on the generous side, are very considerably below the toxic level.

SUPPLEMENTATION WITH COPPER AND COBALT

1. TOPDRESSING OF PASTURES.

Copper.—Topdressing with copper compounds, to raise the copper content of pasture to normal levels, is certainly the ideal method in the more severely deficient

areas, and where improved pastures or crops are grown. Under these circumstances the resultant increases in cereal yields and the increased bulk and impovement in pasture quality amply justify the expenditure involved.

In the very severely deficient areas of the South West improved pastures, notably subterranean clover, cannot be maintained without the use of copper fertilizers. Topdressing with copper, during recent years, has become almost universal in that region, and also in the Gingin, Dandarragan and some other districts.

Animals maintained on treated pastures remain healthy although some care must be excercised in maintaining the copper status of the pasture at a sufficiently high level to prevent the occurrence of "stringy wool."

In most affected areas it has been found that a dressing of 5 lb. bluestone per acre or an equivalent amount of copper ore applied with superphosphate is adequate for 2-3 years both for pasture and animal requirements, although it is often necessary to recommend more frequent dressings for the growth of cereal crops.

Information from South Australia and elsewhere, however, indicates that much heavier topdressings are required on the calcareous sands of the coast, and that it may be ineffective as well as unprofitable to topdress areas of unimproved country carrying native herbage. Again it may not be economic to topdress large areas of developed country where only a "marginal" deficiency of copper exists.

In these cases other methods of copper supplementation must be considered.

Cobalt.—Topdressing with cobalt to supply the cobalt requirement of the animal through the pasture would appear to be the most effective and certain method of control and has much to commend it on locations where the degree of deficiency is severe and where pastures are highly improved and productive.

Where the deficiency is less severe, perhaps only seasonal in occurrence, and where the production per acre is not high it cannot be justified because of economic considerations. As we have already pointed out cobalt is not a plant food, so topdressing does not in any way benefit the pasture and the costs are of course very much higher than those involved in supplying the minute amounts of cobalt needed when given directly to the animal. Topdressing with cobalt is used extensively in New Zealand and in other parts of the world to control cobalt deficiency in sheep and cattle but it has, as yet, been used only to a limited extent in this State, even at Denmark where the deficiency is severe and where pastures are highly productive.

On the information available it seems that a topdressing of four ounces of cobalt chloride or cobalt sulphate per acre should be effective for two years on most soil types. Topdressing of the calcareous coastal sands, however, cannot be recommended; this would be of doubtful efficiency and would in any event be uneconomic.

2. THE ADMINISTRATION OF COPPER AND COBALT TO THE ANIMALS

Under conditions occurring in this State, **with the exception of the coastal runs which present special practical problems,** to be considered later, it has been found generally appropriate to control copper deficiency in sheep and cattle by means of topdressing. The use of licks for sheep, however, may be preferred under some circumstances. Cobalt deficiency in dairy cattle has been controlled largely by the provision of supplements given in the feed, or by licks; relatively few sheep are, as yet, carried in the more severely cobalt deficient regions but licks should provide reasonably effective control, where required.

It must be borne in mind that young stock are more susceptible to cobalt deficiency that older animals. It is therefore, very important that they receive a regular supplement.

In preparing solutions of copper and cobalt non-metal containers, of glassware, enamel, or earthenware, must be used.

Licks

Copper.—The licks recommended for sheep in the past have been (a) Bluestone (copper sulphate) $\frac{1}{4}$-$\frac{1}{2}$ lb.; Salt, 100 lb.

The bluestone is dissolved in rainwater, the solution sprayed on the salt and thoroughly mixed to incorporate the bluestone throughout. **In view of the real danger of copper poisoning from an excessive**

intake it is now recommended that the concentration or intake of the lick be adjusted so that sheep do not eat more than the amount recommended, that is not more than eight ounces of bluestone per 1,000 sheep per week.

(b)—Denmark Lick, which contains 0.6 per cent. of bluestone, has been sometimes used for the same purpose. The concentration of copper in this lick is such that 80 lb. of lick will provide a copper supplementation for 1,000 sheep for 1 week.

Denmark lick has also been used to prevent ataxia in young pigs,* fed at the rate of ½ to 1 oz. per week.

Cattle could be fed either of the above licks at a dose rate of 10 times that recommended for sheep as set out below.

Cobalt.

(a) Denmark Lick.—Since the investigations of Filmer and Underwood *(loc. cit.)* a lick containing limonite, a selected ore containing cobalt (500 p.p.m.), has been widely used for the control of cobalt deficiency in cattle, either mixed in graded doses with feed in the bail, or offered freely in the paddock. This lick consists of two thirds limonite and one third salt, with 0.6 per cent. bluestone added. It has been used also for sheep.

The dose rate recommended is:—

Cattle—1-2 oz. per day.
Sheep—1 oz. per week.

It will be noted that this lick supplies both cobalt and copper requirements.

(b) Cobalt-Salt Lick.—A simple lick containing cobalt and salt may be compounded by the stock owner using—

Cobalt chloride or cobalt sulphate	2 oz.
Salt	100 lb.

This will contain an amount of cobalt approximately equivalent to the Denmark lick, so that the consumption by cattle of 1-2 oz. daily, according to age, or by sheep of 1 oz. per week will be effective in preventing cobalt deficiency.

The control of mineral deficiencies by giving stock free access to appropriate licks is open to a number of objections. The consumption of licks by animals may be variable, some animals not taking enough to correct the dietetic deficiency whereas others may take excessive quantities. The palatability of salt licks, containing mineral supplements, may vary considerably with locality—in some regions salt is eaten avidly by stock, in others, as near the coast, animals may be entirely disinterested. Too frequently also no measures are taken to shelter lick troughs from weathering with the result that the effectiveness of the lick may be lowered because of the leaching out of active constituents. Licks, in general, seem to be taken more readily by sheep than by cattle.

The Use of Solutions

The drenching of animals to control mineral deficiencies has only a limited application but it may be convenient to make use of solutions administered on feed particularly in the control of cobalt deficiency in dairy cattle; this is obviously a very effective method of control where applicable.

The amounts to be used can be based, again, on the fact that 1 oz. of cobalt sulphate or cobalt chloride contains enough cobalt for 100 cattle for one week.

Copper Solutions.—It may be advantageous occasionally to drench sheep with a copper solution which will be stored in the liver and so be effective for some weeks, as for example in the case of lambs which are showing early signs of copper deficiency, or of ewes forward in lamb to prevent the possible occurrence of ataxia in the progeny—this in cases where other methods of supplementation, for some reason, have not been adopted.

To prepare a suitable solution for the purposes indicated dissolve 8 oz. of copper sulphate in 1 gallon of rain water. Give sheep **one** drench of the following amounts:—

Lambing ewes—20 c.c.
Lambs over 4 months—5-10 c.c.
under 4 months—5 c.c.

Cobalt Solutions.—To prepare a suitable cobalt solution dissolve 1 oz. of cobalt sulphate in 1 gallon of rain water. This

---

* For pigs the use of a salt and copper mixture added to the feed has been advocated by Departmental officers for use in the copper deficient areas of the South-West. It is reported as being safe and effective.

A mixture containing 8 oz. bluestone to 100 lb. salt is prepared as directed above.

For use ½ lb. of this mixture is added to each 100 lb. of feed. (The mixed feed so prepared will contain approximately 5 parts per million added copper.)

solution may be given as a drench or given with concentrates, or in the case of calves added to the milk.

The required doses are:—

Cattle—

Adults—30 c.c. (1 fluid oz.) daily.
Calves—15 c.c. ($\frac{1}{2}$ fluid oz.) daily.

(**Sheep**—If it is desired to treat sheep with cobalt solutions this may be conveniently carried out by the use of methods detailed under coast disease, **omitting the bluestone** from the solutions recommended in that section.)

THE CONTROL OF "COAST DISEASE"

The control of the dual deficiency of copper and cobalt on the coast runs in this State presents a number of practical problems for which there is as yet not really a satisfactory solution. Under most conditions topdressing, as we have indicated, would be of doubtful efficiency and is impracticable; licks are not readily taken, particularly by cattle; drenching with solutions needs to be carried out preferably once a fortnight or not more infrequently than once a month in order to prevent losses from cobalt deficiency; the provision of supplements in the drinking water, which has been the most favoured method of control, also has many limitations.

The choice of the method or methods adopted to control "coast disease" must depend on the system of management adopted and upon practical possibilities. We will consider two methods:—

1. Drenching.
2. Supplementation in Drinking Water.

1. Drenching with Copper and Cobalt Solutions.

Lee *(loc. cit.)* for somewhat similar conditions has suggested the following solutions:—

A convenient *stock* solution of copper and cobalt may be prepared by dissolving 1 oz. cobalt sulphate and 8 oz. copper sulphate in one gallon of rain water.

Earthenware, enamelled, or glass containers must be used exclusively, as these solutions destroy iron or galvanized surfaces.

A *dilute* solution, suitable for frequent drenching, is prepared by mixing the stock solution with an equal volume of rainwater. The *dilute* solution will contain approximately 8 mg. cobalt, and 60 mg. copper in each 10 c.c.

These may be used as follows:—

Sheep, of all ages, may be drenched:—

(i) *Dilute solution*—10 c.c. once a week. This will give the maximum response.

(ii) *Stock solution*—20 c.c. once a fortnight. This will be effective.
—20 c.c. once a month. This may prevent losses from coast disease but cannot be expected to maintain stock in good condition.

Cattle, of all ages, can be treated similarly giving 10 times the above doses, that is *stock* solution—50 c.c. or $1\frac{2}{3}$ fluid ounces once a week. 200 c.c or 7 fluid ounces once a fortnight (or once a month).

2. The Addition of Copper and Cobalt Salts to the Drinking Water.

It is difficult or impossible to give regular and accurate quantities of these minerals to cattle and sheep through the drinking water. Nevertheless a rather surprising degree of success in the control of "coast disease" in cattle, carried on the coast during the dry period of the year, has been achieved by rather crude means which will be referred to later. A degree of success has also been obtained on some of the northern coast runs where sheep are maintained for long periods on deficient country.

It has been found, however, that stock waters in many deficient areas contain carbonates in solution; these react with both copper and cobalt salts to form insoluble compounds which are precipitated. The supplements are in consequences not taken in by stock when drinking. Another disadvantage is that sheep drink little water in the winter and spring months when green feed is available.

So far no really satisfactory and economic method has been devised to ensure that the drinking water will contain constant and controllable amounts of the copper and cobalt salts, added as a supplement. The crude method referred to above, which has given a measure of success in the hands of some stock owners, is to wrap in hessian a week's supply of bluestone and cobalt sulphate and immerse it in the water trough just below the ball tap; the salts then dissolve slowly in

the drinking water. Obviously, however, the dose rate received by cattle varies considerably from day to day.

In some instances two holding tanks are used with each trough the required amounts of supplements being added to the tank which is at that time being used to supply the trough. In that way drinking water containing a definite concentration of minerals may be supplied.

The quantities of copper sulphate and cobalt sulphate or chloride to be added to the drinking water are based on the assumption that sheep drink 1 gallon and cattle 10 gallons of water per day.

The required concentration will therefore be:—

Cobalt sulphate or chloride	1 oz.
Copper sulphate	8 oz.
Water	7,000 gallons.

This will provide the needs for 1,000 sheep or 100 cattle for one week.

It should be noted that only cement lined or bitumen painted troughs and tanks must be used because copper solutions corrode metal reservoirs and fittings.

REFERENCES

Beck, A. B. (1941).—*J. Dept. Agric. West Aust.* 18 : 285. (1951).—Dept. Agric. West. Aust. Leaflet No. 678.

Bennetts, H. W. (1935).—*Ibid.*, 12 : 305. (1937).—*Ibid.*, 14 : 247. (1940).—*Ibid.*, 17 : 41. (1941).—*Ibid.*, 18 : 133. (1942).—*Ibid.*, 19 : 7.

Bennetts, H. W., and Hall, H. T. B. (1935).—*Ibid.*, 16 : 156.

Bennetts, H. W., Harley, R., and Evans, S. T. E. (1942).—*Ibid.*, 19 : 96.

Filmer, F. F. and Underwood, E. J. (1936).—*Ibid.*, 13 : 199.

Lee, H. J. (1951).—*Jour. Agric. S. Aust.*, 54 : 475 : 532.

Marston, H. R., Thomas, R. G., Murnane, D., Lines, E. W. L., McDonald, I. W., Moore, H. O., and Bull, L. B. (1938).—Counc. Sci. Ind. Res. Bull. No. 113.

If you own a

DAVID BROWN

CROPMASTER TRACTOR

- The K.L.G. corundite spark plug for engines in first class condition is M30.
- If overheating occurs fit an M50.
- There is a correct type of K.L.G. plug for every petrol and diesel driven engine.

"TOO GOOD TO MISS"

NEW DENNIS 10 h.p. TWIN

AUSTRALIA'S MOST MODERN POWER SAW

MOBILE DRIVEN

Has that power, speed and performance required to carry that 42-inch blade so essential to measure requirements of ....

TIMBER INDUSTRY :: CONTRACT CLEARING :: FENCING

5 h.p. CIRCULAR Suitable for the farmer

Both have many auxiliary purposes and attachments, including POST-HOLE BORER, POST-HOLE DIGGER and **DRAG ATTACHMENT,** if necessary

See Demonstrations at Factory, Maylands

Dennis Power Saws

38 HARDY ROAD, MAYLANDS

TELEPHONE UA 1032

It's FREE

Write now for a coloured brochure on the NEW Dennis Power Saws.

Also gives much valuable information on the handling and maintenance of power saws.

Fill in this coupon.

Please send me New Dennis Saw brochure

Name .....

Address .....

.....

J. of M. Jan./Feb.

CLOVER DISEASE

Practical Findings and Recommendation for Control

By F. L. SHIER, Superintendent of Wheat Farming, and R. C. ROSSITER, Principal Research Officer, Division of Plant Industry, C.S.I.R.O.

DURING the past decade an infertility in ewes together with other breeding troubles and abnormalities of the sex organs of sheep became a serious problem in certain regions in Western Australia where pastures were composed predominantly of early (Dwalganup) subterranean clover.

Briefly the manifestations were infertility, or failure of ewes to get in lamb; dystocia, a condition affecting ewes which had conceived but which made little or no attempt to deliver their lambs and failed to do so; and prolapse and inversion of the uterus (turning inside out of the womb), which occurred typically in the spring, some months after the lambing season. The infertility resulted in a progressive decline in lambing which could, in the course of a few years, fall to below 20 per cent.; the dystocia resulted in death of the unborn lamb and a ewe mortality or wastage of up to 30 per cent.; while prolapse could lead to a 10 per cent. wastage.

Other manifestations were lactation in unbred ewes and in wethers. Wethers also died from urinary obstruction—a small percentage showed a "false bladder" visible externally as a large fluctuating swelling in the crutch; this was almost invariably fatal.

In the March 1946 issue of the Journal of the Department of Agriculture of Western Australia, an account was given of the various manifestations of this disease, the extent of the problem, the knowledge obtained up to that time, together with a number of practical suggestions which it was felt should tend to minimise the overall effects of the disease and keep the total productivity of affected properties somewhere near their normal level.

Since then an intensive investigation has been continued by a team of workers into the pathological, chemical, agrostological and field aspects of the disease. A considerable body of scientific data and a much better understanding of the whole problem has been obtained. Many points still remain obscure and it would appear that much further patient investigation and experimentation will be necessary before this very complex problem, which has resulted in high losses on some properties and at one time appeared to threaten the sheep industry of the 20-25 inch rainfall area of this State, is fully understood.

The more scientific findings have been published by several workers in technical journals from time to time and these have been listed at the end of this article. Here it is proposed to deal only with those points which have a bearing on the practical side of the problem and its control in the light of present knowledge, in the form of a non-technical publication for the general guidance of farmers. This has been considered desirable in view of the additional scientific data now available. It should be pointed out, however, that although we are far from a complete understanding of all aspects of the problem, present experimental data strongly supports the broad general recommendations made in the article.

This article has been prepared by the authors in collaboration with other members of the W.A. Technical Committee on Sheep Infertility.

PRESENT KNOWLEDGE—PRACTICAL ASPECTS

1. The disease is of nutritional origin. It is not due to any infectious organism or the toxins produced by bacteria and eaten by sheep and consequently control cannot be expected by the development of an immunising vaccine such as is the case with entero-toxaemia (braxy-like disease) or botulism (toxic paralysis).

2. The disease results from the grazing of subterranean clover dominant pastures. It has been shown that the clover contains a potent substance, genistein, which has an action on the sheep identical with that of one of the sex hormones, oestrogen. The sex hormones are chemical substances produced, normally, by certain glands in the animal body. They severally control and maintain the various reproductive processes and organs. The continued preponderance of one type of hormone, resulting from the ingestion of potent clover, completely upsets the hormone balance controlling the various reproductive processes. This also induces gross abnormalities in the sex organs of the ewe, notably a cystic condition of the uterus. Wethers are also affected to a lesser extent.

3. The effect of this green subterranean clover grazing is progressive, in the case of ewes. Some cystic condition of the uterus (womb) has been demonstrated in ewe weaners after their first season on green subterranean clover. The degree to which these young ewes have been affected is not great, but it is apparently sufficient to reduce fertility somewhat at their first mating 12 months later, even if they were not on a dominant clover diet during their second winter and spring.

Two seasons of green clover grazing are sufficient to have a distinct effect on the fertility of ewes when mated as two tooths and some incidence of dystocia frequently occurs at lambing time. Maiden four-tooth ewes (mated at two and a half years) following three seasons on green clover are markedly affected, showing definite infertility and generally a high degree of dystocia at lambing of those ewes which had conceived.

4. These effects on the sex organs and fertility of the ewe are largely permanent. Maiden four-tooth ewes and infertile six-tooths (which had not produced a lamb at their first mating) from an affected property exhibited the major manifestations of the disease (infertility and dystocia) at three successive matings on a "sound" area (Merredin) where there was no subterranean clover grazing.

5. The clover appears to be highly potent throughout the green growing period but there is a rapid fall in potency after wilting.

Dry clover and clover hay have been found to contain very low amounts of the potent substance, genistein, and can be consumed by ewes and wethers with impunity.

6. Factors influencing the production of the potent substance in subterranean clover have been studied extensively. It appeared possible that genetic or environmental factors might influence potency, and that if so the disease might be controlled by the use of other (non-potent) varieties of subterranean clover or, for example, by appropriate manurial treatment of the soil.

The evidence strongly suggests that, in the West Australian environment at any rate, all varieties of subterranean clover wherever grown will be dangerous in the green stage, and that sheep will develop "clover disease" if they have a dominant ration of such material for a sufficiently long period.

7. The other plant species of the affected region such as oats, Wimmera ryegrass, volunteer annual grasses, capeweed, Erodium and small "native" clovers even in the green stage, do not contain sufficient genistein to produce harmful effects. On a mixed pasture sheep are less likely to become affected with the disease because of the reduced consumption of subterranean clover.

8. Adequate dressings of superphosphate, in addition to providing good pasture production, will eventually reduce clover dominance owing to the ingress of volunteer (non-clover) plants such as capeweed, brome grasses, etc. Conversely, insufficient phosphate will prolong clover dominance.

9. It appears extremely unlikely that the sudden onset of the disease in the early 1940's was due to any direct effect of war time superphosphate—such as an excess (as an impurity in the superphosphate) or deficiency of a particular element causing the production of the potent factor in clover. The reduced amounts of superphosphate available for topdressing at that time may have tended to produce more dominant clover pastures indirectly, by reducing the overall productivity of the pastures which in turn results in heavy grazing pressure by the sheep.

10. Rams are unaffected. This is no doubt due to the counteracting effect of

the male sex hormone (testosterone), produced by the testicles, which is antagonistic to oestrogen. The effect of testosterone injected into wethers, grazing potent pastures, has been demonstrated experimentally.

The high cost of this substance and other practical considerations, however, absolutely preclude its use for the control of "clover disease" in any of its manifestations.

11. Although earlier evidence from some properties suggested that crossbreds were less susceptible to infertility and dystocia, than were Merinos, recent experience indicates that the former are equally affected. It is quite definite that the changing over to crossbreds cannot be recommended as a means of controlling the disease.

12. Cattle and horses bred and maintained on affected properties have shown no evidence of "clover disease."

CONTROL

It is evident that sufficient information has been accumulated to suggest a system of farm and sheep management which should give a considerable measure of control of "clover disease." This must be based, obviously on measures designed to prevent sheep from regularly eating excessive amounts of green subterranean clover. In recent years many farmers have developed more mixed pastures for their sheep in order to avoid dominant green clover grazing. This has (quite naturally) produced no beneficial effects on their older and "affected" sheep, but farmers who had previously suffered severe losses in their breeding flocks from this disease report marked improvement in their younger sheep which have been maintained under the modified system of management recommended. A very significant feature of the field evidence in the last two years has been the general low incidence of dystocia and prolapse even on properties which had suffered severely in the past.

If we accept the evidence that the genistein content of green subterranean clover is not materially influenced by variety or soil, then obviously the only means of control of the disease short of completely removing the clover is by pasture and sheep management.

For a number of reasons which need not be discussed in this article, subterranean clover is likely to remain an essential component of the pasture if a sound system of agriculture is to be maintained over the region under review. Further research work on the problem is necessary for a complete understanding of the many at present obscure scientific aspects of the problem. Whatever the results of these investigations it is strongly contended that appropriate modifications of husbandry practices, even if not 100 per cent. effective, will undoubtedly result in a much more productive system of farming with greater total returns than have been obtained on farms in the past where sheep have been grazed on more or less dominant pasture periodically topdressed with superphosphate.

PRACTICAL RECOMMENDATIONS

1. Dominant clover pastures should not be grazed in the green period. Such grazing can produce permanent effects in ewes and result in some ill-health and possible losses in wethers. Clover dominant paddocks can be reserved for summer grazing, but are best utilised for meadow hay.

2. If the lambing percentage of a particular flock has dropped to very low figures, say 10 to 15 per cent., it is inadvisable to continue breeding from such ewes. The small percentage of lambs would be more than offset from possible losses from dystocia. It would be best either to keep them unmated solely for wool production or to sell them on the fat stock market.

3. Where the lambing percentage is about 40-50 per cent., it is suggested that at each tailing time all dry ewes be suitably raddled and later mated separately. Those which fail to lamb after this mating, that is after two consecutive matings, should be culled from the breeding flock and disposed of as indicated above. One farmer, by such a programme, associated with appropriate pasture managemant, has improved his lambings from 30-35 per cent. to a normal 70-75 per cent. for the two lambings subsequent to culling.

4. A system of ley farming together with adequate applications of superphosphate should be instituted on clover dominant areas with the dual objective of obtaining greater total productivity and a more balanced grazing for the stock. Wheat is very profitable at the present time and in most affected districts could be used as

the first crop. This may be followed with advantage by a "scratched in" crop of oats and Wimmera ryegrass using the sunderseeder or combine, and would provide a large bulk of good mixed winter and spring grazing. If the paddock is not grazed too heavily in late spring and early summer ample Wimmera ryegrass seed should be set to provide a good pasture in the following year.

5. Pasture improvement should be energetically pursued throughout the clover areas. This should include the introduction and encouragemnt of species other than clover, such as Wimera ryegrass. Good management of the pastures should be followed with attention to such items as topdressing, the avoidance of over-grazing, particularly during the seed setting stage of the grasses, and periodic renovation with the use of "scratched in" crops of oats.

6. Baby beef production, based on such breeds as the Aberdeen Angus, Red Poll or Beef Shorthorn, could be developed with distinct advantage as one of the activities on many farms at present carrying only sheep.

TECHNICAL PAPERS ALREADY PUBLISHED

1. Bennetts, H. W., Underwood E. J. and Shier, F. L.—"A Specific Breeding Problem of Sheep on Subterranean Clover Pastures in Western Australia."—Vet. Journal Vol. XXII Feb. 1946.

2. Bennetts, H. W.—"Metaplasia in the Sex Organs of Castrated Male Sheep Maintained on Early Subterranean Clover Pastures."—Aust. Vet. Journal. Vol. XXII June 1946.

3. Bennetts, H. W.—"A Further Note on Metaplasia in the Sex Organs of Castrated Male Sheep on Subterranean Clover Pastures."—Aust. Vet. Journal. Vol. XXII Jan. 1947.

4. Curnow, D. H., Robinson, T. J., and Underwood, E. J.—"Oestrogenic Action of Extracts of Subterranean Clover (Dwalganup)."—Aust. Jour. Expt. Biol. & Med. Sc. Vol. XXVI 1948.

5. Schinkel, P. G.—"Infertility in Ewes Grazing Subterranean Clover Pastures."—Aust. Vet. Journal. Vol. XXIV 1948.

6. East, June, Underwood, E. J., and Bennetts, H. W.—"Oestrogenic Effects of Subterranean Clover (Dwalganup): Protective Action of Androgen in the Castrate Male."—Aust. Journ. Expt. Biol. & Med. Sc. Vol. XXVII 1949.

7. Robinson, T. J.—"Oestrogenic Potency of Subterranean Clover (Dwalganup): The Preparation and Assay of Abstracts."—Aust. Journ. Expt. Biol. & Med. Sc. Vol. XXVII 1949.

8. East, June.—"Oestrogenic Effects of Subterranean Clover (Dwalganup): Mammary Development in the Castrate Male."—Aust. Journ. Expt. Biol. & Med. Sc. Vol. XXVIII 1950.

9. Bennetts, H. W., and Underwood, E. J.—"The Oestrogenic Effects of Subterranean Clover (Dwalganup): Uterine Maintenance in the Ovariectomized Ewe on Clover Grazing."—Aust. Jour. Expt. Biol. & Med. Sc. Vol. XXIX 1951.

10. Beck, A. B., and Braden, A. N.—"Studies on the Oestrogenic Substance in Subterranean Clover (Dwalganup)."—Aust. Journ. Biol. & Med. Sc. Vol. XXIX 1951.

11. Underwood, E. J., and Shier, F. L.—"The Permanence of the Oestrogenic Effects of Subterranean Clover Grazing on the Ewe."—Aust. Vet. Journal. Vol. XXVII 1951.

12. Alexander, G., and Watson, R. H.—"The Assays of Oestrogenic Activity of *Trifolium subterraneum L.* by Increase in Uterine Weight in the Spayed Guinea Pig."—Aust. Jour. Agric. Res. Vol. II 1951.

13. Bradbury, R. B., and White, D. E.—"The Chemistry of Subterranean Clover. Part I: Isolation of Formononetin and Genistein."—Jour. Chem. Soc. 1951.

14. Underwood, E. J., and Shier, F. L.—"The Incidence of Oestrus in Ewes Grazing on Subterranean Clover Pastures."—Aust. Vet. Jour. Vol. XXVIII 1912.

15. Alexander, G., and Rossiter, R. C.—"The Effects of Fertiliser Treatments on the Oestrogenic Potency of *Trifolium subterraneum L.*"—Aust. Jour. Ag. Res. Vol. III 1952.

16. East, June.—"Oestrogenic Effects of Subterranean Clover: Studies on the Female Guinea Pig."—Aust. Jour. Biol. Sc. Vol. V 1952.

17. Braden, A. W. H., and Peterson, J. E.—"The Persistence of Endometrial Cysts Induced by Oestrogen in the Guinea Pig."—Aust. Jour. Biol. Sc. Vol. VI 1953.

18. Bradbury, R. B., and White, D. E.—"The Chemistry of Subterranean Clover. Part II: Synthesis and Reduction of Isoflavines Related to Genistein and Formononetin."—Jour. Chem. Soc. 1953.

MAIZE GRAIN TRIAL

Denmark Research Station

By F. E. RYAN, B.Sc. Agric., (Hons.), Agrostologist

RAINFALL in the South-West of this State is of winter incidence and as such would not be considered suitable for maize production for grain, but in the lower South some occasional summer rains occur and here maize for grain is successful in selected areas. In addition there are numerous swamp areas which are flooded during the winter months but provide suitable growing conditions with adequate moisture supplies during the summer months.

Maize has been grown for green fodder by dairy farmers for a number of years and occasionally has been used in small areas for grain production.

Tests have been conducted for several years on the Denmark Research Station to determine the comparative yields of maize varieties for grain and especially the newer hybrid varieties which are now commercially available from New South Wales and Queensland. Yields from maize varieties in these trials have been found to vary greatly from year to year according to the amount of summer rainfall received and also to the moisture supplies available from the soil. In 1950-51 the summer rainfall season was good and extremely high yields ranging from the equivalent of 90 to 194 bushels to the acre were obtained in small row trials. The mean yield of a number of varieties in that year was equivalent to 148 bushels to the acre. The general level of yields throughout the years has been much lower than this with means

Fig. 1.—General view of the experimental maize plots at Denmark Research Station.

Fig. 2.—Dawn (NEH6) variety on left with the standard variety Hickory King on right.

of 47.6, 53.2, and 59.6 bushels to the acre for the years 1951/52, 1952/53, and 1953/54 respectively.

The following is an account of the results obtained in a trial during the 1953/54 season when six hybrid maize varieties were tested for grain production for comparison with the open pollinated variety Hickory King.

SITE

The trial was located on Paddock 6 of Denmark Research Station. The soil is a sandy loam soil described by Hosking and Burvill* as Type F sandy loam. It is adjacent to the river at Denmark and retains its moisture fairly well during the summer months. This area had been down to pasture for a number of years prior to the experiment.

DESIGN

Seven varieties were replicated five times in a randomised block layout. Maize was sown in rows five links apart and each plot consisted of one centre row and two buffer rows of one variety. Plots were each 30 links long.

* J. S. Hosking and G. H. Burvill—A Soil Survey of Part of the Denmark Estate. Western Australia. C.S.I.R.O. Bull. No. 115.

PREPARATION, SOWING, ETC.

The land was cultivated in the spring of 1953, allowed a short fallow period and recultivated before being sown in rows five links apart, and 3 cwt. of potato manure "C" containing copper and zinc was applied per acre.

The varieties were sown on December 7, by hand and were thinned to the average of two links apart in the rows after they had emerged. An application of 10 per cent. D.D.T. powder was dusted on the rows for the control of black beetle, and cultivation was carried out as necessary between the rows for weed control.

SEASON

The 1953/54 season was the driest for a number of years. The accompanying table shows rainfall averages for 41 years as compared with the 1953/54 figures.

—	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Total Nov. Apr.	Total Nov. Apr.
Average for 41 years...	182	146	127	133	219	324	570	1,131	1,701
1953–54	288	90	61	41	118	367	442	965	1,407

Opening rains of 1954 season fell on the 17–3–54.

RESULTS

The height, flowering and maturity of the various varieties is shown in the table below:—

	Average Height at Flowering in ft. and ins.	Average No. Days from Sowing.	
		To Flowering.	To Grain Maturity.
	ft. ins.		
DS28	6 4	76	136
Sterling Hybrid (NEH 16)	6 6	77	136
Dawn Hybrid (NEH 6)	6 4	76	148
Emblem Hybrid (NEH 7)	6 4	77	148
DS333 Hybrid	6 2	77	148
Hickory King (open pollinated standard)	6 10	76	155
Standfast Hybrid (GH96A)	6 11	89	156

Earliest maturing varieties were found to be DS28 and Sterling (NEH16), but Dawn, Emblem and DS333 were also earlier than Hickory King, and Standfast (GH96A) was found to be of the same maturity as Hickory King. The latter is considered somewhat late for grain production for the Denmark area.

YIELDS

Yields of the various varieties listed in order of decreasing grain yield is given in the table below. It is obvious that generally hybrid maize varieties were superior to Hickory King in grain production. The highest producing variety in this year's trial was Emblem (NEH7).

Variety.	Grain Yields.		
	Bush./ acre.	Cwts./ acre.	Per cent. of Control Hickory King.
Emblem Hybrid (NEH 7)	70·6	35·3	137
DS28 Hybrid	65·0	32·5	126
DS333 Hybrid	64·2	32·1	125
Dawn Hybrid (NEH 6)	63·6	31·8	123
Sterling Hybrid (NEH 16)	59·0	29·5	115
Hickory King (open pollinated)	51·6	25·8	100
Standfast Hybrid (GH96A)	42·8	21·4	83
General Mean	59·6	29·8	116
Coefficient of Variation (percentage of General Mean)	6·2	....	....
Least Significant Differences—			
At ·1%	19·6	9·8	38·0
At 1%	14·6	7·3	28·3
At 5%	10·8	5·4	20·9

DISCUSSION

For grain production, Hickory King maize is considered to be somewhat late for most areas in this State as when the grain is ripening autumn rains commence, and provide conditions suitable for the development of moulds in the cobs. For this rea-

Fig. 3.—Tall-growing variety Standfast (3 rows) on left and Sterling (NEH16) on right.

son, high yielding varieties which mature earlier than Hickory King are sought. The varieties DS28 and Sterling (NEH16) were most satisfactory from this point of view, ripening in 136 days from the time of sowing to grain maturity. These were harvested on April 22 and were not affected by the autumn rains.

Dawn (NEH6), Emblem (NEH7) and also DS333 were 12 days later than the first two and were still seven days earlier than Hickory King. Standfast (GH96A) is a late maturing variety and ripens in approximately the same time as Hickory King.

Four hybrid varieties, Emblem, DS28, DS333 and Dawn were all superior to Hickory King in grain yields. The highest yielding variety in this trial being Emblem (NEH7) which produced 70 bushels per acre.

The summer of 1953/54 season was exceptionally dry and yields as high as 70 bushels per acre are considered to be very good. Because of the dry season, the difference between early maturing varieties and late maturing varieties would be expected to be exaggerated and this was the case in this trial. Thus, Emblem produced over 50 per cent. greater yield in this season than Standfast (GH96A), although in past trials Standfast Hybrid has given good results.

As Emblem is an early maturing variety, it has an advantage over Standfast in that it ripens sooner and therefore avoids the autumn rains.

SUMMARY

The most satisfactory hybrid maize variety for grain production in this year's trial was Emblem (NEH7) which produced 70 bushels per acre. Other varieties gave good performances—DS28, DS333 and Dawn (NEH6).

HAVE YOU A GARDEN?

If You Have—

ARE YOU SATISFIED WITH RESULTS?

If Not—

Ask your Agent to order you one or two bags of "Florida" or "Mount Lyell"

GARDEN FERTILISER

for inclusion with your Superphosphate order

THE RESULTS WILL SURPRISE AND PLEASE

Cuming Smith & Mount Lyell Farmers Fertilisers Limited

133 St. George's Terrace, Perth :: :: Or any of our Distributors

INSECT Pests AND THEIR CONTROL

By C. F. H. JENKINS, M.A., Government Entomologist

THE CLIMBING CUTWORM

(*Heliothis punctigera* Wallengren)

THE name, "climbing cutworm," is applied to several different species of caterpillars which cause serious economic damage in different parts of the world. The best-known form has such popular names as the "cotton boll worm," the "corn ear worm," and the "tobacco bud-worm," and is known to science as Heliothis armigera. Previous references in local literature have referred to this species, but more exact studies of the insects concerned have revealed that our local pest should be known as H. punctigera (Common, 1953). A change of name is of little interest to the farmer, but an exact knowledge of the different members of the climbing cutworm group, their distribution and food preferences may well lead to discoveries of practical importance. The name "climbing cutworm" is applied locally to distinguish the species from the common cutworm, which seldom feeds up in the foliage, but gnaws plants off at ground level and hides under soil and clods during the daytime.

The parent of the climbing cutworm is a light-coloured moth measuring about 1½ inches across the outspread wings. The forewings are buff-coloured with darker bands running parallel to the outer margins, and with some scattered dark spots. The hind wings are light with broad dark bands on the outer margins.

LIFE HISTORY

The tiny white eggs are laid singly on the foliage of the host plants and hatch in from three to six days, according to conditions. A single female may lay as many as a thousand eggs, but as egg laying is done mainly at night this activity of the moth is rarely seen.

The young caterpillars are dark in colour, but as they feed and shed their skins the various stages show different body markings. The full-grown caterpillars measure about 1½ inches in length and display great colour variation, but usually they are greenish with irregular dark stripes on the back and a light band along each side of the body. The period required for the caterpillar to become fully grown varies greatly according to the type of food available and the weather conditions, but under favourable circumstances the time involved is about 20 days.

When fully mature, the caterpillar descends from the food plant, burrows into the soil, and pupates within a silk-lined earthen cell. The length of the pupal period may only be a couple of weeks, but if weather and temperature conditions are unfavourable this stage may be lengthened very considerably.

HABITS

As already mentioned, the climbing cutworm moth is nocturnal in habits, but it may often be disturbed from weeds in the daytime, when it will make a low rapid flight and quickly disappear again. It is readily attracted to lights, and along with other types of cutworm moths, is a common visitor to lighted rooms on spring and summer evenings.

The caterpillars, although feeding readily on various types of foliage, show a marked preference for fruits and maturing flower heads. In consequence, ripening maize, tomatoes, cotton, linseed, and flax bolls, peas and bean pods, are favourite items of food. Immature almonds, plums, apples, pears and other fruits may also be attacked by the spring brood. A single caterpillar may, of course, go from one fruit or pod to another during feeding, and in the course of its development do a considerable amount of damage.

Fig. 1.—Climbing cutworm moths showing variations in colour and marking (natural size)
(After Quaintance and Brues)

Under local conditions several generations of the climbing cutworm may develop annually. In the drier parts of the State development is retarded in the summer due to lack of moisture, and in these districts the pupae remain dormant in the dry soil until the autumn rains make it possible for the moth to emerge. In flower and vegetable gardens, where constant watering is being carried on, or in the moist southern portion of the State, it may be possible for the insect to develop throughout the year. The generation which is of greatest economic importance is the spring issue, for it is then that such crops as peas, flax, linseed, beans, tomatoes, etc., are commencing to fruit, and when conditions are most favourable for the development of the caterpillars.

The time at which this spring plague appears varies according to the locality. In northern districts such as Geraldton, caterpillars are active about mid-August or early September. In more southern districts, such as Northam and York, October is the critical month, and farther south heavy losses may be experienced in November.

HOST PLANTS

An extensive list of cultivated plants commonly attacked by the climbing cutworm has already been mentioned. In addition to these a large number of weeds and certain garden flowers may support the caterpillars. Rose buds, carnation heads and calendula flowers, to mention a few examples, are often ruined by this pest. Even late patches of wheat may be attacked by the "grub," and the still soft grains may be entirely hollowed out.

The neat manner in which the cutworm eats out the interior of fruits and seeds attacked is quite characteristic, and is well demonstrated in the illustration.

CONTROL

Cultural Methods.

The planting of crops on clean fallow is not as effective against the climbing cutworm as it is against the webworm and the armyworm. The life history details show that moths may fly extensively over fallow-sown crops and lay eggs on the growing plants. The time of planting and the date of maturing of certain crops may.

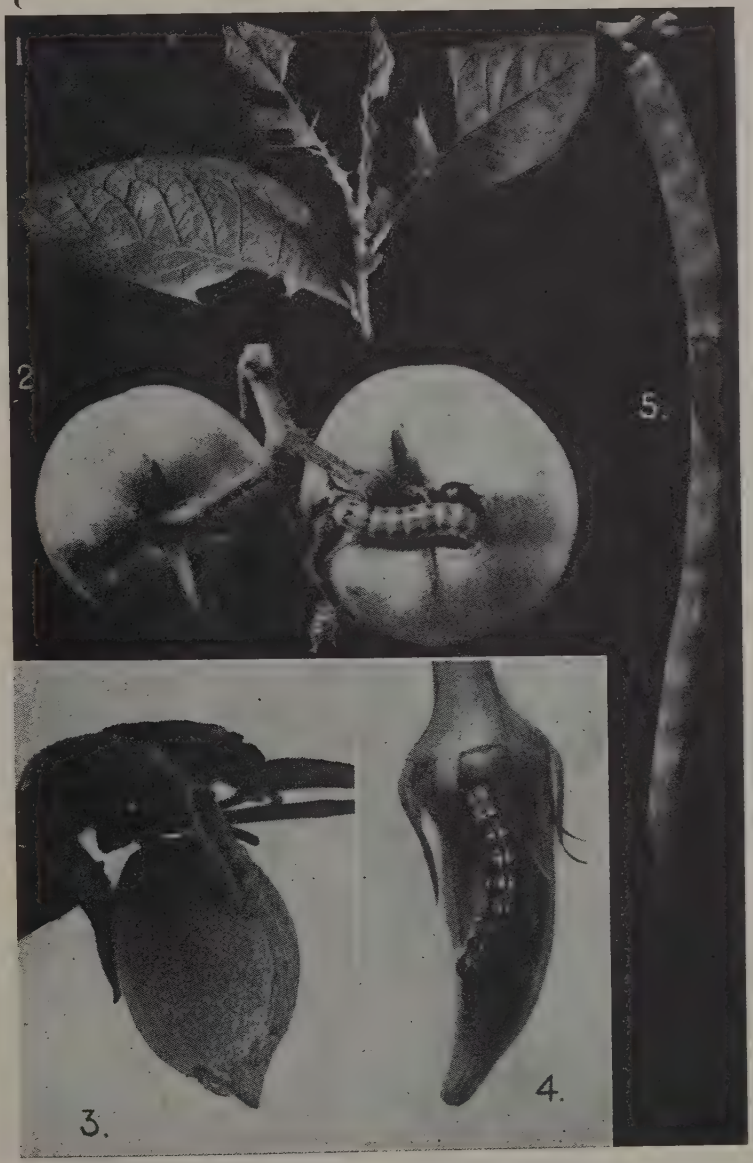


Fig. 2.—CLIMBING CUTWORM INJURY TO PLANTS. (1) Tip of tobacco plant injured by climbing cutworm. (2) Climbing cutworm injury to green tomatoes. (3) Climbing cutworm caterpillar boring into green peach. (4) Okra pod attacked by caterpillar. (5) Caterpillar boring into cowpea pod. (In this illustration (1) is reduced one half, (2), (3) and (4) natural size and (5) is two-thirds natural size.)

(After Quaintance and Brues)

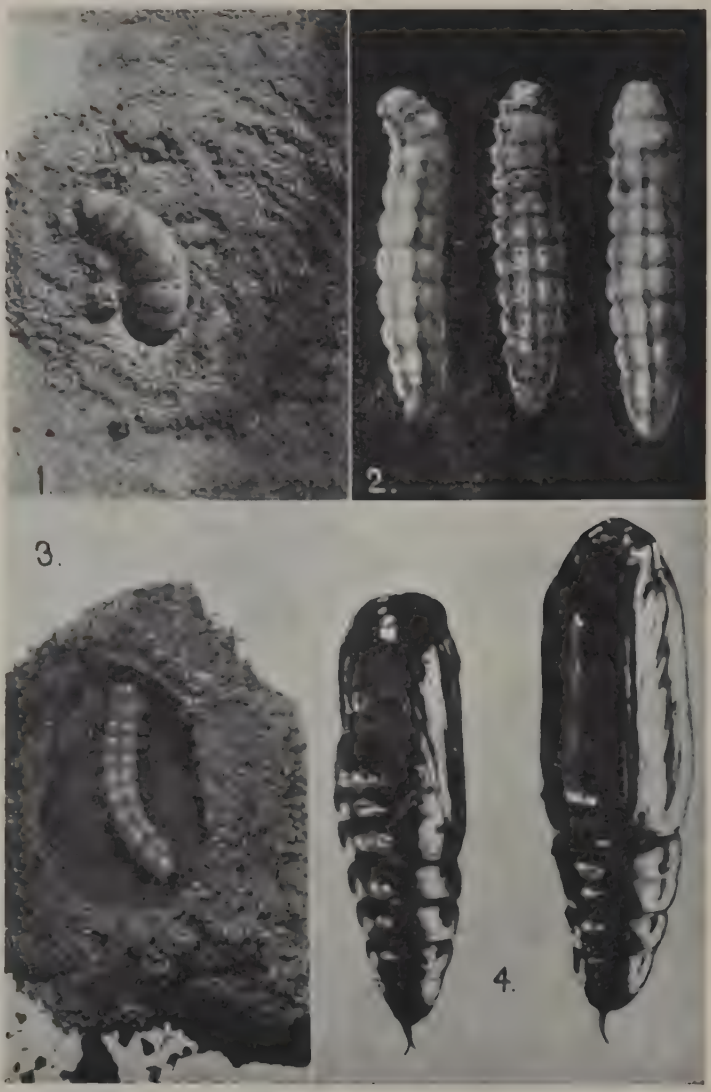


Fig. 3.—PUPATION OF THE CLIMBING CUTWORM. (1) Full grown larva entering soil for pupation. (2) Three larvae showing shrunken appearance just before pupation. (3) Larva in cocoon as made in sandy soil. (4) Two climbing cutworm pupae. (In this illustration (3) is about natural size, (1) and (2) are enlarged one-half and (4) enlarged three times.)

(After Quaintance and Brues)

however, have an important bearing on the degree of caterpillar damage. Early-maturing varieties of field peas such as White Brunswick, for instance, sometimes show appreciably less caterpillar injury than the later-maturing Blue Dunn grown under similar conditions. This also applies to different varieties of flax.

Chemical Treatments.

DDT

Dusts and sprays containing DDT are generally used for climbing cutworm control and give superior results to those obtained with arsenate of lead. For market garden and home grown crops, 2 per cent. DDT dust is one of the most convenient forms of control. For orchard use, 0.1 per cent. DDT spray is recommended, but on field crops, low-volume applications of higher concentration should be used. As a general guide, for the treatment of such crops as lupins, linseed, flax and field peas, the DDT should be applied at the rate of not less than ½ lb. of pure DDT per acre. This means that a quart of 20 per cent. DDT concentrate will treat one acre. The actual rate of dilution will depend upon the output rate of the spray unit. Low-volume spray booms have been used with ground equipment at the rate of 5-10 gallons of liquid to the acre, and aircraft applications are usually as low as 2 gallons per acre. Providing a good cover is obtained, the important thing is the amount of insecticide which is applied to a given area, not the amount of liquid.

Chemical treatments for climbing cutworms should be applied immediately there is any sign of caterpillar activity. The young caterpillars succumb readily to the poison and the residual action of DDT will kill later arrivals. Where large caterpillars are already present, it may be necessary to increase the dosage rate from ½ lb. of DDT to 1 lb. of DDT per acre.

Arsenate of Lead.

If, for any reason, arsenate of lead is preferred to DDT, the following mixtures are suggested:—

(1) Arsenate of lead powder 1 part; slaked lime, talc or kaolin 1 part.

(2) Arsenate of lead powder ½ oz. or arsenate of lead paste 1 oz., water 1 gallon.

The spray mixture should be kept well agitated when in use to prevent the powder settling to the bottom.

LITERATURE

Common, I.F.B., 1953, "The Australian Species of *Heliothis* (Lepidoptera, Noctuidae) and Their Pest Status." Aust. Journal Zool. Vol. 1. No. 3, pp. 319-344.

Quaintance, A. L. and Brues, C. T., 1905. "The Cotton Bollworm." U.S. Dept. Agric. Bur, Ent. Bull. N150.

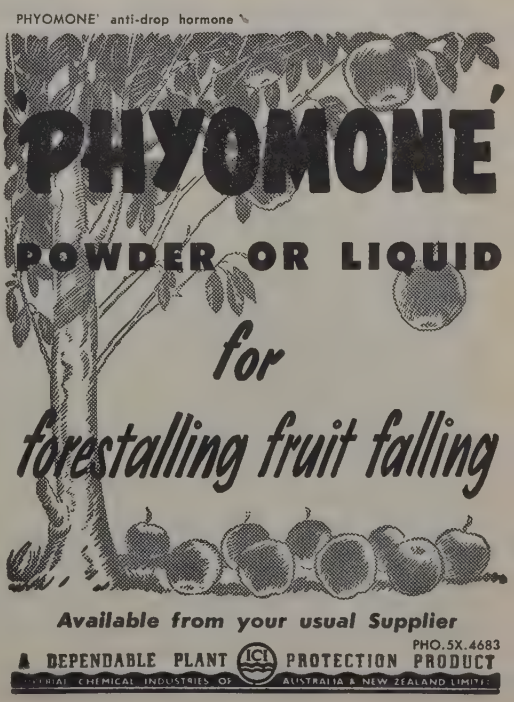


Fig. 1

BUFFEL GRASS (*Cenchrus ciliaris* L.). A—Plant showing habit of growth; B—Burr.

BIRDWOOD GRASS (*Cenchrus setigerns* Vahl.). C—Plant showing habit; D—Burrs.

BUFFEL GRASS (Cenchrus ciliaris L.)

By K. FITZGERALD, B.Sc. (Agric.), Agricultural Adviser

BUFFEL grass occurs in various forms in tropical and sub-tropical parts of Africa and Southern Asia and extends from Arabia to India. It has been found in Madagascar, Socotra and, in more recent years, in the northern parts of Australia. The exact date of introduction into north-western Australia is not known for certain, but it was probably brought in accidentally in camel fodder from India about 1910. The spread of the plant along the coastal areas since that time has been both spectacular and rapid.

In more recent years further strains have been isolated in Africa and these are now being tested under Australian conditions.

A number of native species of the same genus as buffel grass are found in Australia, but mostly they are inferior types and in many cases are regarded as pests; *Cenchrus echinatus* commonly called Gallant's Curse or Cheeky Grass is a well known pest of cultivated areas at Broome (W.A.) and Katherine (N.T.).

DESCRIPTION

Variation in growth habit occurs, but generally it is an erect perennial grass of the tussock-forming type which produces short underground runners; this latter habit is more pronounced in some strains than in others.

Under favourable conditions it forms a dense tussock up to two feet in diameter and 30 inches tall with numerous flowering heads.

Fig. 2.—Buffel grass growing on Mundabullangana Station between Port Hedland and Roebourne. This stand has been grazed fairly heavily before the photograph was taken

Fig. 3.—The top picture shows portion of a Buffel grass paddock at Mundabullangana after heavy grazing during a dry summer. The lower picture, of the same area, shows the response to early winter rains

The degree of leafiness varies with the strain and stage of maturity, but grazing has a marked effect. After heavy and repeated grazing the plants shoot at the nodes and produce clusters of short shoots; these are relished by stock, but the tough wiry stems are usually left untouched.

The fox-tail-shaped seedheads, borne on a short stem, are purplish in colour when young, but change to a dull purplish-brown or yellow-brown colour when mature. There are usually seedheads at all stages of maturity on any one plant. The seeds or burrs bear a number of hairs or bristles near their base, however, these are fairly soft to the touch (as distinct from the seeds of Birdwood grass).

CLIMATIC REQUIREMENTS

Buffel grass is essentially a summer rainfall loving type making its best growth in the hotter months of the year; however, it has the ability to make growth in the cooler months in response to winter rains; this has often been demonstrated in the Broome-Port Hedland areas.

While buffel grass is usually regarded as a drought-tolerant type capable of existing and spreading on a 12-inch rainfall, it thrives at Darwin on a 50-inch rainfall and equally as well at Katherine on a 35-inch rainfall. It appears to make a more luxuriant growth under higher rainfall conditions. Here too, the seed head appears larger and more open while the percentage of leaf to stem appears higher than under less favourable conditions.

In the past it was generally agreed that buffel grass only thrived on the coastal areas where it benefited from an occasional heavy dew. This belief is losing favour in view of the excellent establishment of buffel grass on areas remote from the coast where dews are very rare. Buffel grass does respond to heavy dews, but they are not essential to successful growth.

Leaf damage results from severe frosts, but recovery is usually fairly rapid, especially in the warmer spells during the winter months. Repeated frosts would prove detrimental and this is one of the main reasons why buffel grass has not been grown with any degree of success in southern areas.

SOIL REQUIREMENTS

Buffel grass favours the lighter-textured, freely-drained soils and appears as equally at home on sands as on sandy loams. It grows particularly well on the limestone country adjacent to the coast at Port Hedland.

It has not persisted on the heavy Cunnunurra clay soils in the Kimberleys, but it has been established on the desert loam soils at Murray Downs in the Northern Territory.

The fact that it has failed on the red sandy Pindan soils between Broome and Derby while it thrives on the sandy soils at Broome suggests that the level of soil fertility rather than soil texture may be the determining factor.

SEED

Commercial supplies of buffel grass seed are now available in both Queensland and Western Australia, but it is still in fairly short supply.

In the past, most seed-collecting has been done by hand, but this is slow and costly; there is also a tendency for a certain amount of immature seed to be collected by this method. In Western Australia most of the seed is collected by native labour. Their technique is to scrape it up from the ground after it has fallen and then to separate the seed from the rubbish; this method ensures that most of the seed is mature.

Seed collecting has been mechanised in some areas, but a really efficient method has not yet been perfected. One reasonably effective method is to attach a U-shaped sheet of galvanised iron, fitted with supports, to the bumper bar of a truck or utility. Driven through the crop at 8 to 10 miles per hour the device works quite effectively and only mature seed falls into the trough.

Pioneers in the establishment of buffel grass areas have been aware for many years of the necessity of planting mature seed. Freshly collected buffel grass seed has a very low germination percentage, but this improves with storage. Tests carried out at Port Hedland have shown that freshly-collected seed with a germination percentage of 3% could be improved to 71% by keeping the seed for two years

before using. The price and scarcity of seed make this an important consideration.

SEEDING RATE

Experience has shown that 2½ to 3 lb. of seed per acre is sufficient to give a satisfactory stand provided the seed is fully mature; this should give two or three plants to the square link.

Seeding rates of 4 or 5 lb. to the acre have been used with success in heavier rainfall areas adjacent to the coast and on more fertile soil types. However, with the scarcity of seed and its high cost the lighter seeding rates are recommended.

PLANTING TECHNIQUES

Buffel grass is readily established from seed, but to ensure a satisfactory strike it must be sown on broken ground and covered lightly. Excellent stands result from planting into a well prepared seedbed.

Tandem disc harrows or an ordinary tyne cultivator have been used with success. After broadcasting seed it is advisable to cover it with up-turned harrows or with a bush dragged behind a vehicle.

Disappointing results have come from broadcasting on to hard, bare, unprepared ground.

On stations where suitable machinery is not available, a useful technique is to drive cattle over the area both before and after broadcasting the seed to break the soil and tread the seed into it. Most station managers appreciate the effectiveness of scattering buffel grass seed around stock yards and watering points. The broken ground assists in the establishment and later the stock assist in the dispersal of seed; it is possible too, that the extra manure around these areas promotes a more vigorous growth.

The bristly nature of the seeds makes an even distribution through a seed drill a difficult undertaking as the seed tends to block the drills. The use of a hammermill to remove these bristles is an advantage while mixing with sand or sawdust ensures an even distribution.

Pelleting of the seed with superphosphate and some musilaginous substance does assist, but it is doubtful whether the extra labour involved is worthwhile.

On large pastoral holdings, probably the quickest and cheapest method of establishing buffel grass over extensive areas in a short time is by resorting to "strip-planting"; here single runs with a seed drill are made a couple of chains apart and the grass is left to spread between the runs by natural means. Again, small fenced plots, say one chain square, are planted, as seed increase plots; these, placed strategically around the run to make the best use of the prevailing winds for seed dispersal, should greatly facilitate the spread of grass over the run.

Every station interested in the establishment of buffel grass should at least have their own seed increase plot from which to draw their seed. A five acre paddock is a useful size for such a project and it will be found most useful for the odd night horse held occasionally at the homestead.

Fig. 4.—Broken ground is essential for Buffel grass establishment. Here where contour working was carried out on claypans, seed was broadcast over the whole area shown in the photographs, but germination only took place on the cultivated strips

MANAGEMENT

The secret of success with buffel grass pastures lies in correct management; faulty treatment within the first 12 months of establishment can ruin an otherwise satisfactory stand.

As a general rule, newly-established areas should not be grazed for the first 12 months.

Under adverse conditions, seed is often set within six week of planting at which stage the plants are only three or four inches tall; it would be foolish to put stock on such an area.

An established stand can withstand heavy grazing; in fact, it is essential that it be kept short. Stock relish the young tender shoots and regrowth, but often refuse the mature plant.

Palatability and feeding value decline with age and both protein and phosphorus values fall to fairly low levels as the plant matures; the following table indicates this trend:—

With heavy dense stands it is advisable to use a mowing machine and then graze the regrowth, adjusting the stocking rate so as to keep the grass fairly short. Continued overgrazing is detrimental especially on new areas.

Where cattle and sheep are run on the same property it is advisable to graze mature stands first with cattle to remove heavy growth and then turn the sheep in to graze the shorter material.

Periodically the crop should be allowed to set seed before it is grazed in order to re-thicken the stand.

Buffel grass can be cut and baled as hay; the product being quite good in both feeding value and keeping quality. Even if baling is not possible, a mature stand can be cut and left in the paddock; the stock will eat quite a lot of the dry material and even though some is lost the quality of the regrowth will be greatly improved.

An occasional fire in a buffel grass area will cause no serious permanent damage, but frequent burnings are to be avoided.

CHEMICAL COMPOSITION OF BUFFEL GRASS (on Water-Free Basis)
Ref. Marriott.—Queens. Agric. Journal, Jan., 1953

Grass.	Protein.	Fat.	Carbohydrate.	Fibre.	Ash.	CaO.	P_2O_5.	Remarks.
	%							
Buffel	18·0	1·6	40·7	27·0	12·7	·95	·67	Young growth.
Buffel	8·3	0·8	43·7	38·5	8·7	·272	·157	Stemmy leaf; with ripe seed.
Buffel	5·6	1·2	52·8	30·4	10·0	·25	·154	Dry stemmy plants.

Fig. 5.—Ten-weeks-old Buffel plants in test rows at Woodstock Station, 100 miles inland

FERTILISER REQUIREMENTS

Marked responses have been obtained from topdressings with superphosphate, especially on the lighter soil types, but the response on heavier soils is not so marked.

Again, old buffel grass stands show signs of nitrogen starvation and the response to a topdressing of 1 cwt. of ammonium sulphate to the acre is quite spectacular.

From an economic standpoint it seems more desirable that efforts be made to establish some type of legume with buffel grass to improve the nitrogen status of the soil rather than relying on expensive artificial fertilisers. Further experimentation

into the economic aspects of applying artificial fertilisers to buffel grass pastures seems warranted.

CONCLUSIONS

Buffel grass has already displayed its ability to establish and spread over extensive areas of our North-West. This, coupled with its high degree of drought tolerance, its palatability and high nutritive value makes it a particularly valuable introduction whose role in the North-West could almost be comparable in importance with that of subterranean clover in the southern portions of the State.

Probably the most important points to remember when establishing buffel grass are:—

1. Use only mature seed—18-24 months old—seed at the rate of 3 lb. to the acre.
2. Plant into broken ground—preferably light soils—and cover the seed.
3. Protect from grazing for the first 12 months.
4. Once established, graze heavily to prevent coarse, rank growth.

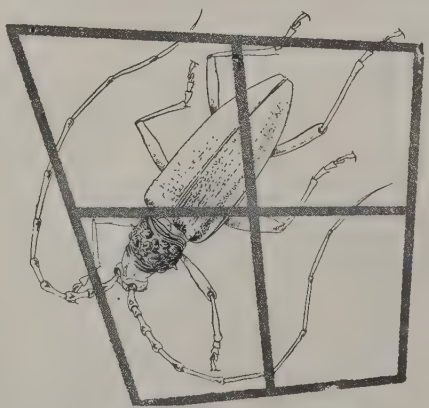
REFERENCES

"Buffel Grass"—S. Marriott and K. B. Anderssen—Queens. Journal of Agric. Jan. 1953.

"Buffel and Birdwood Grasses—Two Useful Perennials"—H. Suijdendorp. W.A. Journal of Agric. July-Aug., 1953.

"Flora of W.A."—Vol. I, by C. A. Gardner.

There are no rotten metal windows



No insect can eat a metal window. No termite, no fungus can destroy it. There are no rotten metal windows—and no warped, swollen or shrunken metal windows either. That is why you find **"RELIANCE" METAL WINDOWS** doing an equally good job in England or Australia, Malaya or Canada, in India or Peru.

With our past experience, we are confident that we can help you with your window problems.

UTILITY BUILDINGS PTY. LTD.
89 ST GEORGES TERRACE PERTH · B2250 BF1674

Branches at ADELAIDE, MELBOURNE, SYDNEY and BRISBANE.

Suppliers of Windows, Doors and all kinds of Steel Buildings for Agricultural Purposes

LEUCOSIS IN FOWLS

By P. M. A. HARWOOD, M.R.C.V.S., Veterinary Surgeon

THE prevalence of leucosis in commercial flocks has become a serious problem to the poultry industry. The disease is a chronic one and usually runs a prolonged course. The losses occur irregularly, but the total of deaths during the course of the season may be heavy and since they mainly occur in the laying flock they represent a serious loss to the poultry farmers. To this must be added the losses resulting from depressed egg production and the cost of feeding unproductive birds.

There is much that is yet to be learnt concerning leucosis, despite extensive research programmes extending over a number of years. Much conflicting evidence has been produced so that it is not possible to make definite statements on many points.

MODE OF INFECTION

Leucosis is a transmissible disease affecting all breeds of poultry and appears to be caused by a virus. Artificial transmission experiments indicate that the birds are most susceptible to infection up to the age of eight weeks and it is probable that chicks running in infected yards and picking up the infection at this early age are the major source of infected birds. The disease is also spread by blood-sucking insects and mites and there is also evidence to indicate that transmission of the disease through the egg may occur. As some strains of birds within the breed are susceptible, while others are resistant, the picture is somewhat complicated.

THE LEUCOSIS COMPLEX

Leucosis is a disease with many manifestations, all of which probably have a common cause and may occur simultaneously. The virus acts upon the blood cells or blood-forming tissues, causing them to behave abnormally. The term "leucosis" refers to a cancer-like condition of the blood cells or blood-forming tissues whereby abnormal numbers or types of cells are present in the circulating blood; or alternatively these cells are deposited in the tissues in the form of cancerous tumours.

Those forms of the disease in which cells are deposited in the tissues in the form of tumours are known as lymphatic leucosis or lymphomatosis and the four main types of this disease are:—

Fig. 1.—A bird suffering from neural leucosis or "fowl paralysis"

1. Visceral leucosis where the abdominal organs are the site of the tumours.

2. Neural leucosis (Fowl Paralysis) where the nerves are affected.

3. Ocular leucosis, where the eyes are affected (Pearly Eye).

4. Osteopetrotic leucosis where the leg bones are affected (Thick Leg Disease).

The types of leucosis where the circulating blood is affected are Erythroblastosis and Granuloblastosis (wasting anaemia).

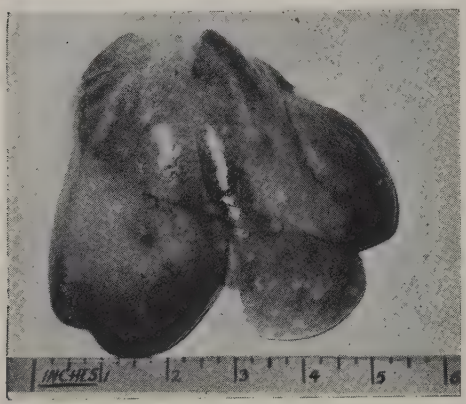


Fig. 2.—Enlarged liver from a bird which died from visceral leucosis. Note greyish areas and projecting tumors

In both these forms the normal blood corpuscles are replaced by enormous numbers of abnormal cells.

Other manifestations of leucosis also occur but they are so uncommon that, they need not be included in this discussion.

SYMPTOMS AND POST-MORTEM FINDINGS

1. **Visceral leucosis.**—In Western Australia this form of the disease is the one that is most frequently encountered. The majority of deaths from this disease occur in birds between 5½ and 18 months of age.

Birds affected usually show wasting, loss of appetite, yellowish diarrhoea, and pale shrunken combs. Dropsy may develop, but many deaths occur in birds which are apparently in good condition and showing no definite symptoms.

At post-mortem examination, any organ to the body may be affected, but the liver, kidney and spleen are most often involved. The liver may be enlarged to several times its normal size and may show a number of small pearly areas or large masses of greyish or whitish material. Tumours may be seen projecting from the surface. The spleen is frequently enlarged, usually with greyish areas visible throughout the tissues. The kidneys may be enlarged and infiltrated with grey material.

In pullets and hens, the ovaries are frequently affected and may show cysts, tumours, or cauliflower-like growths.

A form is frequently seen in which the peritoneum and mesentery (those membranes which line the abdominal cavity and support the bowels) show multiple small grey tumours somewhat resembling tuberculosis. (Tuberculosis has not been diagnosed in poultry in Western Australia).

2. **Neural leucosis.**—This form of the disease is commonly referred to as fowl paralysis, and partial or total paralysis of the legs is the most frequent manifestation, although the wings or neck may also be affected. One or both of the legs may be stretched forward or backward and may be completely useless. A typical early sign is the loss of the reflex action in which the bird's toes are clenched when it is raised suddenly and opened when it is dropped. If the paralysis affects the wings these will be carried in a drooped position and where the neck is affected there is a twisting and abnormal carriage of the head.

This form is due to the infiltration of the nerves with lymphatic cells and this may be evidenced by swellings on the course of the nerve, or may only be detectable by microscopic examination.

3. **Ocular leucosis.**—The iris of the eye in a normal fowl is brightly coloured, for example, it is orange in White Leghorns and brown in Australorps. When the bird is affected by ocular leucosis, the iris loses its normal colour and becomes a pearly grey. For this reason a common name for the complaint is Pearly Eye. The pupil is distorted and loses its ability to contract when exposed to a bright light.

Birds affected with ocular leucosis are blind in the diseased eye but may otherwise appear quite normal and healthy. They should be immediately discarded however as they will be carriers of the disease.

Fig. 3.—Typical ocular leucosis or "pearly eye." The bird is blind in this eye

4. **Osteopetrotic leucosis.**—This form is the rarest of the lymphatic types of leucosis and appears to be more common in cockerels than in hens and pullets. The shank bones become enlarged and the legs appear boot-like. This disease should not be confused with "scaly leg" which is due to a mite. In "scaly leg," the scales are raised, rough and powdery whereas in osteopetrotic leucosis the scales remain smooth and shiny.

5. **Erythroblastosis.**—This a true wasting disease and may be referred to as wasting anaemia. The bird progressively wastes away to a skeleton and the head and comb become pale. It may take several months before this stage is reached.

On post-mortem examination small blood-spots are seen in he bowels while the liver, kidneys and spleen are enlarged, pale, soft and fragile.

6. **Granuloblastosis.**—The symptoms in this condition are practically indistinguishable from Erythroblastosis but on post-mortem the liver may be mottled with grey.

TREATMENT

No treatment is effective against any of the forms of leucosis. Spontaneous recovery from the neural (fowl paralysis) type may occur, but as these birds will be carriers they should be disposed of.

CONTROL

The control of leucosis falls into two categories.

1. **The Use of Resistant Strains.**—Resistant strains occur within all breeds of poultry and when purchasing birds an attempt should be made to ascertain whether the disease has been present in the parent flock and whether control measures are being adopted.

Mature birds which have been exposed to infection as young stock and have survived may be expected to possess a considerable degree of resistance and while a proportion of them may still be susceptible it is a sound practise to breed from second and third year hens rather than from pullets. The policy of pullet breeding assists in the spread of the disease as fowls are often producing for some months before symptoms become apparent. This means that susceptible strains may be perpetuated and the disease transmitted via the egg. By using second and third

Fig. 4.—An advanced case of osteopetrotic leucosis or "thick leg"

year hens for breeding stock and by the reduction of all "pearly eye" and "fowl paralysis" cases, resistant flocks may be built up. However, it is frequently difficult to apply this principle in practise since the old birds are often out of production when eggs most required for incubation and it becomes necessary to rely upon the pullet flock.

2. **Hygienic Measures.** — Since young birds are most susceptible during the first weeks of life it is of the utmost importance that they should be protected from infection during this period and that they should not be allowed access to yards which have been occupied by adult birds.

SUMMARY

1. Fowl leucosis is a disease which causes considerable financial loss every year to poultry farmers as the disease principally affects laying birds.

2. The disease is a complex one because a single cause (the virus) gives rise to five separate clinical forms of the disease. These are:—

   (a) Visceral leucosis (big liver disease) where cancerous tumours occur in various organs.
   (b) Neural leucosis (fowl paralysis).
   (c) Ocular leucosis (pearly eye disease).
   (d) Osteopetrotic leucosis (thick leg disease).
   (e) Erythroblastosis and Granuloblastosis (wasting anaemia).

All these forms occur quite frequently (with the exception of "thick leg disease") and several types may occur simultaneously in the same flock. In Western Australia the visceral type is the commonest manifestation of the disease.

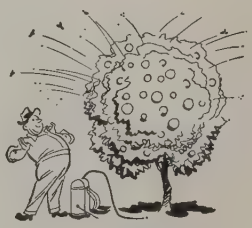
3. The disease may be controlled by:—

   (a) Using resistant strains.
   (b) Avoiding pullet-bred stock.
   (c) Hygienic measures.

4. Treatment is of no avail and should never be attempted. All affected birds should be destroyed as soon as they are recognised.

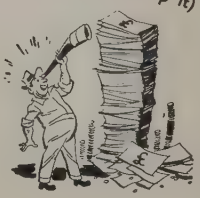
'PESPRUF' D.D.T. Dusts and Sprays

on goes 'PESPRUF'
(Straight to the attack)



out go insects
(Flat on the back)

up go the profits
(You just can't stop it)



'PESPRUF' D.D.T.

20 EMULSION SPRAY
50 DISPERSIBLE POWDER

FOR FRUIT, VINES AND VEGETABLES

W.A. Distributor:
Westralian Farmers' Co-op. Ltd., 569 Wellington St., Perth

PES. 18W. 2822

A DEPENDABLE PLANT ICI PROTECTION PRODUCT

IMPERIAL CHEMICAL INDUSTRIES OF AUSTRALIA & NEW ZEALAND LIMITED

LICE AND TICK IN SHEEP

Some notes on the recognition and control of two serious pests.

By C. R. TOOP, Chief Veterinary Surgeon; C. F. H. JENKINS, Government Entomologist; and W. L. McGARRY, Sheep and Wool Adviser

BODY lice and the so called "ticks" or keds are the most serious of the external parasites which infest sheep in Western Australia, and, unless they are controlled by systematic dipping, these pests can be the cause of considerable financial loss to flock owners. The sheep body louse (Damalinia ovis), which is able to propagate under hot dry conditions, has a wide distribution and occurs in both the agricultural and pastoral areas. The so-called tick or ked (Melophogus ovinus) has a much more restricted distribution and is confined to the higher rainfall areas of the South-West portion of the State.

Isolated cases of infestation with the sheep foot louse *(Linognathus pedalis)* also occur, but this parasite shows little tendency to spread throughout the flock and is consequently not of much economic importance.

Sheep infested with vermin show symptoms of skin irritation which causes them to rub against fences and other objects and to scratch and bite at the wool which in consequence presents a torn and ragged appearance. In heavy infestations the wool becomes matted and discoloured and is thereby depreciated in value. In addition the constant irritation of the parasites may result in considerable loss of condition and a reduction in the weight of the wool produced.

For the detection of these parasites the wool should be opened and examined in a good light. Ticks, on account of their reddish-brown colour and large size, (about ¼in. in length) are unlikely to be overlooked and when present will usually be found on the lower parts of the body, i.e. the belly, flanks and underside of the neck. Lice are much smaller, measuring only 1/25 in. in length but their movements in the fleece will readily be detected when a close examination is made in a bright light.

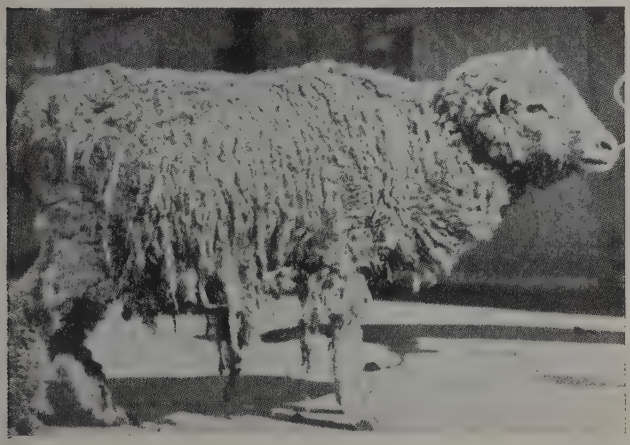


Fig. 1.—Sheep infested with lice and ticks. Note torn and ragged fleece, due to rubbing
(Journal of Agriculture of S.A.)

SYMPTOMS OF INFESTATION

Sheep infested with lice and tick suffer from constant irritation and may frequently be seen rubbing against fences, trees or posts. They often bite at the skin and may sometimes be seen with tufts of wool in their mouths.

The fleece of an infested sheep is discoloured and matted and usually has a bedraggled appearance due to rubbing and scratching in efforts to relieve the skin irritation caused by the parasites.

Vermin infestation considerably reduces the value of the clip and the constant irrita-

tion caused by the parasites is responsible for loss of condition and a reduction of fleece weights.

DESCRIPTIONS

Sheep lice are true insects with flattened bodies and strongly-clawed legs admirably adapted for living among the sheep's wool. Two types of lice occur locally, one having the broad squarish head and mouth parts adapted for biting, and the other possessing a more pointed head and tubular mouth parts adapted for sucking blood. Both of these lice together with the so called "ticks" are permanent parasites and all stages in their life cycles are spent on the body of the host animal.

The Red Headed Sheep Louse

(*Damalinia ovis Schr.*)

This is the common sheep louse in Western Australia. It is generally distributed throughout the South-Western Division of the State and extends northward—where its distribution is chiefly coastal—to the Port Hedland district.

The insect measures about 1/25th in. in length and its abdomen is of a pale brownish colour with several dark transverse bands. The reddish head is more densely pigmented, giving rise to the popular name of the parasite.

The mouth parts of this louse are of the biting type and are adapted for feeding on the scurf and other debris lying on the surface of the skin. The situations most favoured are the neck, shoulders, back and thighs, but in severe infestations the insects spread to almost all parts of the body.

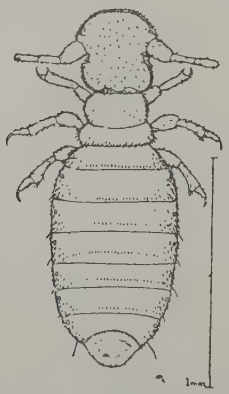


Fig. 2.—The Red Headed Sheep Louse (greatly magnified) (After Monnig)

Life History.

The eggs or "nits" of the red-headed louse are fastened on to the wool and hatch in from six to ten days. The young lice closely resemble the parents in all but size, and after moulting or casting their skins several times reach sexual maturity in about 18 days.

The Foot Louse

(*Linognathus pedalis Osb.*)

The foot louse is much larger than the red-headed louse and measures about 1/12th in. in length. It has a short, bluntly-pointed head with mouth parts adapted for the sucking of blood. As its name infers, this species of louse is found chiefly on the hairy parts of the legs, but may spread to adjacent parts of the body.

Fig. 3.—Sheep Foot Louse (male) (about 50 times natural size)

The Foot Louse is not common in Western Australia and has a very scattered distribution. Its permanent habitat seems to be in the vicinity of Carnarvon and other isolated Gascoyne localities. Records from South-West districts have been received, but usually such infestations have been traced to the introduction of sheep from Northern districts.

The life history of this louse differs only in minor detail from that of the red-headed louse.

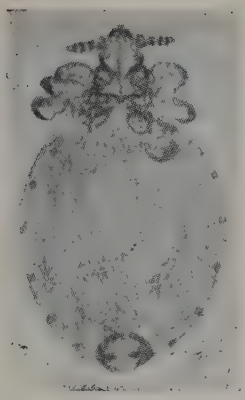


Fig. 4.—Sheep Foot Louse (female) (about 50 times natural size)

Sheep Ked or "Tick"

(*Melophagus ovinus L.*)

This insect is not a true tick but a wingless fly. The term "tick" is quite misleading as the true sheep tick does not occur in this State. The true tick is an eight-legged creature whereas the sheep ked has the six legs typical of insects. On account of its high specialisation as a parasite, the wings have been lost although certain close relatives of the sheep ked still possess wings and are often known as louse-flies.

The sheep ked measures about ¼in. in length and is reddish or grey-brown in colour. The abdomen is disproportionately large and swollen, especially when the insect is fully gorged with blood. The mouth parts are adapted for blood sucking and protrude as a conspicuous proboscis in front of the head.

When disturbed, the keds move very rapidly through a fleece, darting sideways and backwards with a crab-like action. They are commonly found on the neck, breast, shoulders, belly and thighs of the sheep.

Life History.

The eggs of the sheep ked are retained by the female until they hatch and the larvae or maggots are not deposited until fully grown. They are then attached to the wool fibres and pupate almost immediately. The entire life cycle is therefore passed on the sheep and yet no eggs or active maggots will be seen on an infested animal. The keds emerge from the brown barrel-shaped pupae in about 22 days and reach sexual maturity after a further fortnight or three weeks. A single female ked is considered to be capable of producing about 15 pupae.

Means of Distribution and Survival Capacity of Lice and Keds

Lice and keds never voluntarily leave the body of the host animal and are incapable of breeding or surviving long periods away from their normal environment. The adult ked, however, has been reported to live as long as 18 days detached from the sheep, and pupae have been recorded to survive as long as 42 days in tags of wool.

The survival period of lice detached from the host is usually given at about five days, but this will naturally vary according to whether the insect is exposed in a paddock or protected in a shearing shed.

From the foregoing it will be apparent that sheep may become infested in two ways. Close contact between clean and infested sheep in yards, trucks and shearing sheds contributes mostly to the spread of the pests, but the danger of tags of wool lying about shearing shed floors and adhering to the sides of sheep pens cannot be ignored.

Fig. 5.—Ked and Pupa (about four times natural size) (By courtesy E. Murray Pullar, B.V.Sc.)

Effect of Lice and Ked Infestation on Sheep

The presence of lice and keds can be detected by the scraggy and ragged appearance of the infested animals. The irrita-

tion caused by the feeding of any of the parasites greatly disturbs the stock and causes them to be constantly scratching, biting or rubbing the affected areas. In the case of blood-sucking foot louse and ked infestations, the actual loss of blood involved also helps to weaken the host. Affected sheep rapidly lose condition, and the standard of the fleece is adversely affected.

Control measures are outlined elsewhere in this article and the importance of carrying out these measures regularly and carefully cannot be over emphasised. Every farmer, however, should strive to keep his flock entirely free of tick and lice, and the most effective way of doing this is to see that infested animals are not brought on to the holding.

Fresh purchases should be carefully examined before being given a free run of the property, as prompt action in connection with a few head of stock may often prevent widespread trouble later in the season.

DIPPING IS COMPULSORY

Under the Stock Diseases Act Regulations dipping is compulsory in the South-West division of the State as well as in the Dundas, Esperance, Westonia and Yilgarn Road Districts and those portions of the Merredin, Narembeen, Lake Grace and Phillips River Road Districts, situated outside the South-West Division. This legislation is necessary to ensure that tick and lice are controlled on individual properties and its purpose is to prevent the spread of vermin from infested to clean properties by the sale of undipped sheep. Systematic dipping connotes good sheep husbandry and on well managed properties it is practised as an annual routine, making compulsion unnecessary.

There are still many farmers and graziers, however, who are unmindful of the losses occasioned by the presence of vermin in their flocks and are indifferent to the losses that may be sustained by others from the indiscriminate sale of infested, undipped sheep. The enforcement of the dipping regulations is, therefore, essential. A copy of these regulations has been appended for the information of sheep owners.

CONTROL BY DIPPING

Dipping Fluids.

Vermin infestation in sheep may be controlled by systematic dipping. There are many reliable brands of sheep dip on the market and while none of these can be specifically recommended by the Department all of them may be expected to give satisfactory results provided they are used in strict accordance with the directions of the manufacturers. The choice of a dip, however, will depend upon the parasite it is desired to control and it should be recognised that a dip which is effective against one type of parasite will not necessarily control another.

Neither the eggs nor "nits" of the lice nor the pupae of the tick are destroyed by dipping fluids and it is necessary to select a dip that will not only destroy the adult parasites but will also destroy the young parasites as they subsequently emerge. Both the life cycle of the parasite and the residual toxicity of the dipping fluid must therefore be considered.

Young lice hatch from the eggs in nine or 10 days whereas a period of 22 days is required for the emergence of young ticks from the pupae. The residual toxicity of arsenic is of short duration and while it is sufficient for the destruction of young lice as they hatch it does not remain in the wool long enough to destroy young ticks as they emerge from the pupae.

Gammexane (benzene hexachloride) and derris dips on the other hand have a prolonged residual toxicity and are retained in the wool long enough to destroy both young lice and young ticks as they emerge.

It will thus be seen that arsenical dips although effective for the eradication of body lice will not control ticks whereas the gammexane (BHC) dips and the so-called double acting dips which contain both arsenic and derris will when correctly used control both of these parasites.

Gammexane dips suffer a disadvantage in that they tend to "strip" or become reduced in strength during use and this is most likely to occur when a small volume of fluid is used for the treatment of a large number of sheep as in a shower spray or a dip of small capacity.

Allowance for this reduction in strength has however been made by the manufacturers when calculating the amount of dip to be added to the bath to maintain the dipping fluid at an effective concentration and it is essential that the directions supplied both with regard to the mixing and topping up or replenishment of gammexane dips should be strictly observed if satisfactory results are to be expected.

For the control of foot lice, gammexane dips are recommended and may with advantage be used at double strength although this is not essential.

The above recommendations may be summarised as follows:—

Body Lice—use arsenical or gammexane dips.

Tick—Use arsenic and derris or gammexane dips.

Tick and Body Lice—Use arsenic and derris or gammexane dips.

Foot Lice—Use a gammexane dip.

The arsenical dips are stable and do not "strip" or become reduced in strength, and they may be generally recommended for the control of body lice. A single thorough dipping in an arsenical preparation can usually be relied upon to eradicate these parasites from the flock.

Best results in the control of tick will probably be obtained with gammexane although the arsenic-derris dips are also effective. Arsenic alone will not control tick.

TIME OF DIPPING

Best results will be obtained by dipping immediately after shearing. Recent investigations have shown that the closer to shearing that dipping is carried out, the more effective it will prove to be. In order to avoid infection from the absorption of arsenic through open wounds, it is advisable to delay dipping until shearing-cuts have healed. It may be noted however, that under station conditions, many thousands of sheep are dipped straight off the board without suffering any ill effects.

When it is realised that the majority of the parasites present in the fleeces will be removed by shearing and that those remaining will be more vulnerable to the effects of the dipping fluid while the wool is short, the advantages to be gained by early dipping will be readily apparent.

The Stock Diseases Act Regulations require that sheep should be dipped within six weeks of the date of shearing.

ERADICATION

Provided that a dip of the type recommended is used, a single annual dipping will effectively control both tick and lice, but where it is desired to make doubly sure that complete eradication will be achieved, a second dipping three weeks after the first is advisable. This is a wise precaution to take with heavily-infested flocks.

CAREFUL DIPPING ESSENTIAL

Care should be exercised to ensure that the dip is of the correct strength and that the sheep are completely immersed. All sheep on the property—including rams and lambs—should be dipped at the one time, since any animals that are left undipped will soon re-infect the remainder of the flock. The capacity of the bath should be accurately estimated and the dip should be added in the proportions directed by the manufacturer and thoroughly mxed. The bath should be of sufficient length to ensure that the sheep will be saturated with the dipping fluid and the head of each animal should be ducked beneath the surface as it swims through the bath. Where shower dips are employed treatment should be carried out within a month of shearing otherwise the dipping fluid will not penetrate and saturate the fleece. The sheep should be held in the enclosure long enough to ensure that all parts of the fleece are thoroughly saturated. Where unsatisfactory results are obtained from dipping they can usually be attributed to failure to observe these precautions.

DIPPING DON'TS

DON'T dip hot or thirsty sheep; yard them near the dipping site some time before dipping and allow them time to rest and settle down and thoroughly cool off before commencing operations.

DON'T drive sheep immediately before or after dipping. If the sheep are over driven or shedded after dipping there is a risk of scalding of the skin due to "sweating."

DON'T dip your sheep in wet weather as if heavy rain falls upon newly dipped sheep before they are dry they will scald and mortalities can occur.

DON'T dip sheep in very cold weather.

DON'T dip sheep late in the day so that they are unable to dry out before sundown.

DON'T dip sheep in very hot weather because sheep that are soaked with dip fluid are liable to scald under a very hot sun.

DON'T allow newly dipped sheep to be exposed to hot sun or wind. Always allow the sheep to dry in the shade in preference to drying in the sun.

DON'T allow sheep to leave the bath or spraying enclosure until the dipping fluid has had time to soak through to the skin.

DON'T forget to plunge the sheep's head under twice with a guiding crutch if using a swim dip. Always allow breathing time between the plunges and never hold a sheep under the fluid. When plunging a sheep always push it backward and give the second plunge just before the sheep reaches the exit slope.

DON'T forget to dip all sheep on the property at the same time. This includes ration sheep, rams and lambs, any of which could be responsible for reinfestation of the flock if dipping is omitted.

STOCK DISEASES ACT REGULATIONS

PART VI.—SHEEP AFFECTED WITH TICK AND LICE

Dipping or Spraying of Sheep Compulsory in Specified Areas.

63. (1) Subject as hereinafter provided and unless otherwise authorised by the Chief Inspector of Stock, every owner of sheep within the boundaries of the district specified in paragraph (2) of this regulation shall within six weeks next after the date of shearing in each year, dip or cause to be dipped in a swim bath or saturated by a shower spray approved by the Chief Inspector of Stock and prepared from some specific known to be fatal to tick and lice all sheep running upon land whereof he is the owner or occupier.

(2) This regulation shall apply to the South-West Division of the State, to the Dundas, Esperance, Westonia and Yilgarn Road Districts as constituted under the Road Districts Act, 1919-1946, to all those portions of the Merredin, Narembeen, Lake Grace and Phillips River Road Districts situate east of the No. 1 Rabbit Proof Fence, and to any other such road district which may subsequently be specified by a notice published in the *Government Gazette*.

(3) No sheep shall be removed from any land or offered for sale privately or by auction in any part of Western Australia specified in paragraph (2) of this regulation unless such sheep have been dipped or sprayed subsequent to shearing in a preparation known to be fatal to tick and lice provided that dipping or spraying shall not be necessary in the case of sheep forwarded within six weeks of the date of shearing direct from the property of the owner to an abattoir or meat works for the purpose of immediate slaughter.

(4) If any sheep which have not been dipped or sprayed as required under paragraph (3) of this regulation are found in any yard or yards or on any land or other place where sheep are offered for sale, the owner of the sheep shall be liable to a penalty not exceeding £50 and any inspector may order the withdrawal of the sheep from sale until they have been dipped or sprayed to his satisfaction.

(5) When any sheep are intended to be offered for sale in any part of Western Australia to which this regulation shall apply the owner of the sheep shall if required by any inspector make a statutory declaration in accordance with Form 5A of the Third Schedule hereto, to the effect that the sheep were dipped or sprayed subsequent to shearing and shall state therein the date of shearing, the date of dipping, and the brand and quantity of dip used.

Penalty for having Affected Sheep on Property.

64. (1) If any sheep affected with tick or lice shall be found upon any property on which sheep are grazed, the owner or occupier of the land on which the affected sheep are depasturing shall be guilty of an offence, and any inspector may give notice to the aforesaid owner or occupier of the land on which the affected sheep are depasturing to dip, spray or dress the sheep forthwith in such manner and at such place as the inspector of stock may direct, and every such owner or occupier who refuses, neglects or fails to comply with the aforesaid notice shall be liable to a further penalty.

(2) No sheep affected with tick or lice shall be offered for sale privately or by auction or removed from the property on which the sheep are being depastured until they have been dipped in, or sprayed with, some specific known to be fatal to tick and lice, provided that permission may be granted by the inspector to remove them to an approved dipping or spraying place.

Sheep Infested with Tick or Lice must be Dipped or Sprayed.

65. (1) If an inspector is satisfied that stock depasturing in any part of the State is affected with tick or lice, he shall give the owner thereof notice to dip or spray such stock forthwith to the satisfaction of the inspector or his agent.

And any owner who refuses, neglects, or fails to comply with such notice on or before the date specified therein shall be liable on conviction to a penalty not exceeding fifty pounds for the first offence, and if immediately after conviction for the first offence such stock shall not be dipped or sprayed to the entire satisfaction of the inspector, such owner shall upon conviction be liable to a further penalty not exceeding fifty pounds, and so on for each and every succeeding conviction.

(2) If any sheep affected with tick or lice shall be found in any pound, or in any yard or yards, or on any land or other place at which sheep are offered for sale or exhibited for show purposes, the owner exposing the sheep so affected shall be liable to a penalty not exceeding fifty pounds, and any inspector, if he deems it necessary, may order the withdrawal from sale of any sheep affected with tick or lice until such sheep have been dipped, sprayed or dressed to the satisfaction of such inspector or any other inspector, and may give notice to the aforesaid owner of such sheep to dip, spray or dress the same forthwith, at such place as the inspector may direct; and every such owner who refuses, neglects, or fails to comply with the aforesaid notice shall be liable to a further penalty not exceeding twenty pounds. But if the inspector is satisfied that such sheep are intended for immediate slaughter, he may withhold such notice to dip or spray.

Stud Sheep.

66. Every owner, occupier or person in charge of any holding in the South-West Division of the State shall, before the removal of any stud sheep, make a statutory declaration, according to Form No. 5 in the Third Schedule hereto, that such sheep are free from tick and lice. If such sheep are found to be suffering from tick or lice, such owner, occupier or person in charge shall cause them before removal to be dipped in a swim bath or saturated with a power spray approved by the Chief Inspector of Stock prepared with some specific known to be fatal to tick and lice, and shall make a declaration according to Form No. 6 in the Third Schedule hereto, that they have been so dipped or sprayed.

Statutory Declaration to be Supplied Within Fourteen Days after Dipping or Spraying.

67. Within fourteen days after the dipping or spraying of his sheep the owner shall make a statutory declaration before a justice of the peace to the effect of Form No. 7 in the Third Schedule hereto, stating that he has dipped or sprayed his sheep in accordance with the provisions of these regulations, the date of dipping or spraying, the number of sheep dipped or sprayed, and the class of dip or spray used, and he shall forward such declaration to the Chief Inspector of Stock.

Ewes with Lambs—Time for Dipping or Spraying.

68. Notwithstanding anything contained in these regulations, it shall not be necessary to dip or spray ewes affected with ticks or lice during such time previous to or after their lambing as the inspectors may appoint, and for such purpose any inspector may, in respect of such ewes, extend any notice to dip or spray for such time as he shall think fit.

Permits to Move Sheep into the Compulsory Dipping Area.

69. (1) No sheep shall be travelled by road or conveyed by rail, motor or other transport into the compulsory dipping area as defined in regulation 63 (2) of these regulations from any part of Western Australia situated outside the compulsory dipping area without the written permission of an Inspector of Stock, and the inspector shall not issue a permit for the movement of the sheep unless he is satisfied that they were dipped or sprayed subsequent to shearing with a preparation known to be fatal to tick and lice and until he has received from the owner or his manager a statutory declaration in the form of Form No. 7A of the Third Schedule hereto stating the last date of shearing, the date of dipping, the number of sheep dipped, and the quantity and brand of the dip used. Every person contravening this regulation by act or omission shall be punishable summarily and upon conviction be liable to a penalty not exceeding fifty pounds and not less than ten pounds.

(2) Where sheep are affected by drought and are too weak to be dipped subsequent to shearing or are intended for immediate slaughter at a meat works or for export for slaughter they may be moved into the compulsory dipping area subject only to the written permission of an Inspector of Stock and to the condition that the property to which any such stock exempted from dipping because of drought are transferred shall be ordered into quarantine which shall be maintained until the total number of the sheep on the said property have been dipped to the satisfaction of an inspector.

Affected Stock not Allowed to Stray.

70. Every person who by himself, his agent or servant, drives, without the permission of an inspector, or suffers to stray across or upon any land, or drives, depastures, or suffers to stray upon or along any highway any sheep which have not been dipped according to these regulations, or which are affected with ticks or lice shall be liable on conviction to a penalty not exceeding fifty pounds.

FORM No. 5 (Regulation No. 66).
Western Australia.

Department of Agriculture.

Stock Diseases Act, 1895.
DECLARATION.

I, (1).....
of (2).....
in the State of Western Australia (3).....
do solemnly and sincerely declare that ..... stud sheep now on my holding, which stud sheep I have sold to..... of.....
are free from TICK AND LICE.

And I make this solemn declaration by virtue of Section One hundred and six of "The Evidence Act, 1906."

Declared at.....
this ..... day of ..... 19 ....., (4).....
before me,

.....
Justice of the Peace.

(1) Christian name or names and surname of declarant in full.
(2) Address.
(3) Calling.
(4) Ordinary signature of declarant.

(To be forwarded to the Chief Inspector of Stock.)

FORM No. 7 (Regulation No. 67).

Stock Diseases Act, 1895.

DECLARATION.

I,..... of.....
situated in the ..... Road District in the State of Western Australia, do solemnly and sincerely declare that I have dipped or sprayed the whole of the sheep at present depasturing on my farms and runs, and belonging to me, and at present in my possession.
No. of sheep dipped.....
Brand and Quantity of Dip used.....
Date of Dipping...../...../19.....

And I make this solemn declaration by virtue of section One hundred and six of the Evidence Act, 1906.

Declared at.....
this..... day of..... 19 ....., ...
before me, Ordinary Signature of Declarant.

.....
* Justice of the Peace or other authorised person.

*Pursuant to section 2 of Act No. 12 of 1913, the following persons are authorised to attest Statutory Declarations: Town Clerk, Secretary to Road Board, Electoral Registrar, Post Master, Classified Officer of State or Commonwealth Public Service, Classified State School Teacher, Member of Police Force, Commissioner of Declarations.

FORM No. 7A (Regulation 69).
Stock Diseases Act, 1895.
DECLARATION.

I,..... of.....
situated in the.....Road District in the State of Western Australia, do solemnly and sincerely declare that the.....(number) sheep which I intend forwarding by.....(road, rail or motor transport) from.....(place of origin) to.....(destination) for the purpose of.....(sale or agistment) by.....(name of agents if by auction) were dipped (or sprayed) subsequent to shearing in a preparation known to be fatal to tick and lice and are to the best of my knowledge and belief free of these parasites.

Date of last shearing.....19.....
Date of dipping.....19.....
Brand and quantity of dip used.....
Wool brand.....

And I make this solemn declaration by virtue of section One hundred and six of the Evidence Act, 1906.

Dated at.....

this.....day of.....19.....,

Before me

.....

* Justice of the Peace or other authorised person.

.....
Ordinary Signature of Declarant.

* Pursuant to section 2 of the Act No. 12 of 1913, the following persons are authorised to attest Statutory declarations: Town Clerk, Secretary to Road Board, Electoral Registrar, Post Master, Classified State School Teacher, Classified Officer of State or Commonwealth Public Service, Member of Police Force, Commissioner of Declarations.

FORM No. 6 (Regulation No. 66).
Western Australia.

Department of Agriculture.

Stock Diseases Act, 1895.

DECLARATION.
(No. 28 of 1906).

I (1) .....
of (2) .....
in the State of Western Australia (3).....
do solemnly and sincerely declare that.....stud sheep which were sold by me to.....
of.....and which were found by me to be suffering from Tick (or Lice) were within.....of their removal from my holding dipped in or sprayed with (state material used).....
in the proportion of (quantity of dip or spray used and how diluted).....
.....

Declared at.....

this .....day of .....19.....,

before me,

.....
Justice of the Peace.

(4).....

(1) Christian name or names and surname of declarant in full.
(2) Address.
(3) Calling.
(4) Ordinary Signature of Declarant.

(To be forwarded to the Chief Inspector of Stock.)

FORM No. 5A (Regulation 63 (5)).

Stock Diseases Act, 1895.

DECLARATION.

I, ...

of .....

in the State of Western Australia, do solemnly and sincerely declare that the ..... sheep which are intended to be offered for sale at.....

by .....(agents) were dipped (or sprayed) subsequent to shearing in a preparation known to be fatal to tick and lice.

Date of Shearing...../...../19.....

Date of Dipping or Spraying...../...../19.....

Brand and Quantity of Dip used .....

And I make this solemn declaration by virtue of section One hundred and six of the Evidence Act, 1906.

.....

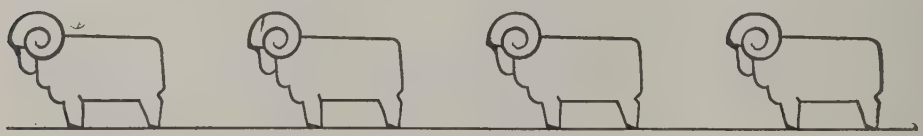
Ordinary Signature.

Dated at..... this.....day of .....19..... Before me—

.....

* Justice of the Peace or other authorised person.

*Pursuant to section 2 of Act No. 12 of 1913, the following persons are authorised to attest Statutory Declarations:—Town Clerk, Secretary to Road Board, Electoral Registrar, Post Master, Classified Officer of State or Commonwealth Public Service, Classified State School Teacher, Member of Police Force, Commissioner of Declarations.



THE STATE GOVERNMENT INSURANCE OFFICE

For Motor Vehicle Comprehensive & Workers' Compensation Insurance

194 ST. GEORGE'S TERRACE, PERTH

And at Kalgoorlie and all Clerks of Court

TEL. BA 9966 :: :: :: :: :: :: Telegrams "WASIO"

BOOKS... *for FARMERS*

FARMERS are among the most book-minded sections of the community today, yet one often hears it said that "Farmer's don't want books." The statement is only true, in that it is not things that people want but their effects. People don't want refrigerators for instance, but they do want the things that the "fridge" can give them—fresh foods, ice-cream and cold beer. If people don't want books, they do want knowledge, new ideas, romance, adventure, and all the things that books can provide.

That is what the Library Board is for, to supply these things that people, particularly country people, want. Superficially the board provides books, actually it provides relaxation, interests, ideas, information.

The board was set up by the Government to encourage and help local authorities in the establishment of local public libraries and to supply the books needed by them on a circulation system, so that new books, both novels and non-fiction, are regularly fed into each library to replace those which have already been read. This ensures that the library remains fresh and attractive to readers, and avoids the staleness which made most libraries in the past dull and unpopular. The board pays for the cost of the books, provided that the Road Board or Municipality concerned will arrange for them to be housed and issued to readers.

In addition to supplying and maintaining a stock of books at each library, the board will also supply on request through a local library any book in the whole State stock, or any information, which may be needed. If the book or information needed is not in stock, it can probably be bought, or borrowed from another library. Thus almost any book published or the answer to practically any question can be supplied on request. In the settled areas of the State the request must come through the local library, but people who live in extreme isolation in the north or east of the State can be supplied direct from Perth if they write to the board.

To help farmers keep abreast of new books on agricultural and related subjects, a list of some of the books recently added will be published in each future issue of the Journal. Those who live in places where the Road Board or the Municipality has had the foresight to join the Library Board's scheme will be able to obtain any book listed free on application to the local library. People who live in other places (except those in the North-West or North who may borrow direct from Perth) will not of course be able to borrow the books, but at least they will know what is being published and will be able to buy any books which interest them.

The board plans to spend about £1,000 this year on agricultural books and because of the nature of the Journal the list will be more or less restricted to a selection from such books, but books on all other subjects and, of course novels, are continually being added so that not only the farmer, but his wife and family, and everyone else, will find something to meet their particular taste or interest.

Further information on the scheme will gladly be supplied on application to the Library Board of Western Australia, 11 Havelock Street, Perth.

LIST OF SOME BOOKS ON AGRICULTURE
in the stock of
THE LIBRARY BOARD OF W.A.

GENERAL

AGRICULTURE, by R. P. Connell and J. W. Hadfield. 6th ed. Melb., 1950.
THE AUSTRALIAN ENVIRONMENT. C.S.I.R.O. 2nd ed. Melb., 1950.

ELEMENTS OF AGRICULTURE, edited by W. Fream. 13th ed. Lond., 1949.
FARMERS IN A CHANGING WORLD. United States Department of Agriculture. Washington, 1940.
A HANDBOOK OF TROPICAL AGRICULTURE, by G. B. Masefield. Oxford, 1949.
MODERN FARMERS' CYCLOPEDIA OF AGRICULTURE, by E. V. Wilcox. N.Y. 1944.
SCHOOL AGRICULTURE AND JUNIOR FARMERS' TEXT BOOK, by E. Breakwell and G. H. Wright. 6th ed. Syd., 1953.
SCIENCE IN FARMING. United States Department of Agriculture. Washington, 1947.

FARM MANAGEMENT

BRITISH WHEELED TRACTORS. "Farm Mechanisation" Lond., 1952.
FARM MACHINERY, by C. Culpin. 4th ed. Lond., 1952.
FARM MACHINERY AND TRACTORS, by R. H. Cochrane. Christchurch, N.Z., 1951.
THE FARM WORKSHOP, by H. J. Hine. Lond., 1953.
MECHANISED AGRICULTURE, by C. Davies. Lond., 1950.
PRACTICAL FARM BOOKKEEPING AND COSTING, by D. M. Malloch and I. W. Weston. 3rd ed. Christchurch N.Z., 1953.
PROGRESS AND ECONOMIC PROBLEMS IN FARM MECHANISATION. Food and Agriculture Organisation of the United Nations. Washington, 1950.
TECHNICAL ANNUAL, 1953. "Power Farming in Australia and New Zealand." Syd., 1953.

SOIL AND CROP MANAGEMENT

THE DIAGNOSIS OF MINERAL DEFICIENCIES IN PLANTS BY VISUAL SYMPTOMS, by T. Wallace. 2nd. ed. Lond., 1951.
ELEMENTS OF TROPICAL SOIL SCIENCE, by T. Eden, Lond., 1949.
THE FEEDING OF CROPS AND STOCK, by Sir A. D. Hall, 3rd ed. Lond., 1944.
HARNESSING THE EARTHWORM, by T. J. Barrett. Lond., 1949.
INTRODUCTION TO SOIL SCIENCE, by G. W. Leeper. 2nd ed. Melb., 1952.
THE KEYLINE PLAN, by P. A. Yeomans. Syd., 1954.

Breeders: **Australorp, W/Leghorn, 1st Cross**

DAY OLD CHICKS:

Unsexed, Pullets and Cockerels when available

APRIL to OCTOBER DELIVERY, FREIGHT FREE—Air Freight Extra

6 WEEKS-OLD PULLETS

MAY to NOVEMBER DELIVERY

Plus freight and boxing

All from Government Blood Tested PROVED SECOND SEASON STOCK

HATCHERY:

Cnr. EPSOM & SMITH AVE'S REDCLIFFE PARK — ML 543

LIFE FROM THE SOIL, by H. F. White and Sir C. S. Hicks. Melb., 1953.
A MANUAL OF AUSTRALIAN SOILS, by C. G. Stephens. Melb., 1953.
PLANT BREEDING, by A. L. Hagedoorn. Lond., 1950.
PRESERVATION OF GRAINS IN STORAGE. Food and Agriculture Organisation of the United Nations. Rome, 1948.
PROPAGATION OF PLANTS, by M. G. Kains and L. M. McQuesten. New ed. N.Y., 1942.
THE RAPE OF THE EARTH, by G. V. Jacks and R. O. Whyte. Lond., 1939.
THE SOIL, by Sir A. D. Hall. 5th ed. Lond., 1945.
SOIL CONDITIONS AND PLANT GROWTH, by Sir E. J. Russell. 8th ed. Lond., 1950.
SOIL CONSERVATION, by H. H. Bennett. N.Y., 1939.
SOIL CONSERVATION. Food and Agriculture Organisation of the United Nations. Washington, 1948.
SOIL RESTORATION, by E. H. Faulkner. Lond., 1953.
SOIL SURVEYS FOR LAND DEVELOPMENT. Food and Agriculture Organisation of the United Nations. Rome, 1953.
WEED CONTROL, by W. W. Robbins and others. 2nd ed. Lond., 1952.

PRODUCTION OF CROPS

BLADES OF GRASS, by H. C. Trumble. Melb., 1948.
FORAGE CROPS, by G. H. Ahlgren. N.Y., 1949.
GRASS. United States Department of Agriculture. Washington, 1948.
THE GREAT AUSTRALIAN PASTURE REVOLUTION! British Farm Equipment Pty. Ltd. Melb., 1953.
HUNGER SIGNS IN CROPS. Washington, 1949.
IMPROVING THE WORLD'S GRASSLANDS. Food and Agriculture Organisation of the United Nations. Lond., 1952.
LEGUMES IN AGRICULTURE. Food and Agriculture Organisation of the United Nations. Rome, 1953.
PASTURE AND FODDER DEVELOPMENT IN MEDITERRANEAN COUNTRIES. Organisation for European Economic Co-operation. Paris, 1951.
PASTURE PRODUCTION AND MANAGEMENT, by R. H. Lush. N.Y., 1952.
PRINCIPLES OF FIELD CROP PRODUCTION, by J. H. Martin and W. H. Leonard. N.Y., 1949.
THE PRODUCTION OF TOBACCO, by W. W. Garner. Rev. ed. N.Y., 1951.

FRUIT GROWING AND FORESTRY

CITRUS DISEASES AND THEIR CONTROL, by H. S. Fawcett. 2nd ed. N.Y., 1936.
THE CITRUS INDUSTRY, eds. H. J. Webber and L. D. Batchelor. Berkeley, Calif., 1943.
THE CULTIVATION OF CITRUS FRUITS, by H. H. Hume. N.Y., 1926.
DECIDUOUS ORCHARDS, by W. H. Chandler. Lond., 1942.
ELEMENTS OF FOREST FIRE CONTROL. Food and Agriculture Organisation of the United Nations. Rome, 1953.
THE ENCYCLOPEDIA OF FRUITS, BERRIES AND NUTS AND HOW TO GROW THEM, by A. E. Wilkinson. Philadelphia, 1945.
THE FORESTER'S HANDBOOK, by H. L. Edlin. Lond., 1953.
FRUIT TREE AND GRAPE VINE PRUNING, by G. Quinn, 10th ed. Melb., 1953.
THE LEMON FRUIT, by E. T. Bartholomew and W. B. Sinclair. Berkeley, Calif., 1951.
MODERN FRUIT PRODUCTION, by J. H. Gourley and F. S. Howlett. N.Y., 1941.
ORCHARD AND SMALL FRUIT CULTURE, by E. C. Auchter and H. B. Knapp. 3rd ed. N.Y., 1937.
TREES. United States Department of Agriculture. Washington, 1949.

LIVESTOCK

ANIMAL BREEDING, by A. L. Hagedoorn, 4th ed. Lond., 1950.
ANIMAL SCIENCE, by M. E. Ensminger. 2nd. ed. Danville, Ill., 1951.
BREEDING AND IMPROVEMENT OF FARM ANIMALS, by V. A. Rice and F. N. Andrews. 4th ed., N.Y., 1951.
DISEASES OF LIVESTOCK, by T. G. Hungerford. 3rd ed. Syd., 1953.
FOOD AND LIFE. United States Department of Agriculture. Washington, 1939.
INSECTS AFFECTING LIVESTOCK, by F. H. S. Roberts. Syd., 1952.
KEEPING LIVESTOCK HEALTHY. United States Department of Agriculture. Washington, 1942.
STOCK POISONING, by T. E. K. Ryan. Syd., 1947.
A WORLD DICTIONARY OF BREEDS, by J. L. Mason. Farnham Royal, Commonwealth Agricultural Bureau, 1951.

The instructor demonstrates before interested trainees, showing how to control the handpiece in finishing off the last hind leg

SHEARING SCHOOLS

A Successful Innovation

By W. L. McGARRY, Sheep and Wool Adviser, J. REILLY, Sheep and Wool Instructor, and M. BUTLER, Shearing Instructor

TO assist in overcoming the shortage of skilled shearers—which has become a major problem in the State's sheep and wool industry—the Department of Agriculture conducted a series of 14-day instructional courses in shearing at Fremantle during 1954. A total of 57 trainees passed through the shearing schools and all of these received engagements as learner shearers during the 1954 season—in fact applications for the services of the learners exceeded the number available.

Due to various reasons the quantity of shearing labour available in Western Australia, particularly in the agricultural areas, has not kept pace with the rapid increase in the sheep population. This has meant that in many cases farmers were compelled to shear their sheep earlier, or later, than was desirable in order to fit in with the shearers' itineraries.

The following figures show the rapid increase in sheep numbers which has taken place in the agricultural areas.

Season	Number
1949-50	7,974,810
1950-51	8,931,302
1951-52	9,748,432
1952-53	10,311,827
1953-54	10,745,322

It will be seen that during the past five seasons there has been an increase of over three million sheep and it is expected that this tendency will be maintained, necessitating even more shearing labour in future years.

The shearing schools were made possible by the ready co-operation of Elder Smith and Company Limited, who made their shearing shed and plant available, also the willing assistance of a wholesale butcher who supplied the sheep. It is worth re-

1—Instruction in grinding combs and cutters. 2—Demonstrating the correct setting of the toothplate. 3—A lesson in shearing. 4—A trainee grinding a cutter under supervision. 5—A second week trainee in action. 6.—Beginners at an early stage of training.

cording also that these schools were instituted with the full approval of the Australian Workers' Union who have co-operated to the fullest extent in establishing the schools on a practical basis.

More applications than could be handled were received from would-be shearers, among whom were included farmers' sons, rural workers and city youths all over the age of 17. The applicants were interviewed and those considered most suitable were allotted to various schools in groups of six to each school. Each group was given instruction under actual shearing shed conditions between the hours of 9 a.m. and 4 p.m. each day for a period of two weeks.

At the commencement of the course, the trainees were instructed in the correct setting up and maintenance of handpieces. They were instructed in the elementary principles of correct shearing technique and were given partly-shorn sheep to complete, in order to enable them to acquire some degree of control of the handpieces and the sheep. Later instruction included the shearing of different parts of the sheep, until eventually the trainees were able to complete the shearing of a sheep without assistance.

At the commencement of the second week of the course it was noticed that most of the trainees were commencing to gain confidence but it was still necessary for them to be supervised and corrected. Towards the conclusion of the course the trainees, although under constant supervision, were encouraged to become more self-reliant in preparation for their entry into sheds as learner shearers.

Special emphasis was placed on teaching the trainees how to control and bring the sheep into the correct positions for shearing, and the importance of developing a good style was also stressed. They were instructed how to fill and keep the comb on the skin and how to run the handpiece in a free flowing manner so as to remove the maximum amount of wool with the minimum number of "blows," thus avoiding ridging and second cuts. Trainees were also taught how to crutch sheep correctly and were given instruction in grinding combs and cutters.

It was realised that these short instructional courses were not sufficient to turn out accomplished shearers, but the purpose of the school was to ensure that when trainees completed their courses they would have a grounding in shearing sufficient to qualify them to take learners' pens, and with constant practice they should eventually develop into skilled tradesmen.

The schools were a qualified success and woolgrowers, in the main, were quite satisfied with the work performed by these learners—so much so that the Department has been officially requested to continue the instructional schools during 1955.

HORMONES CHANGE VINEYARD PRACTICE

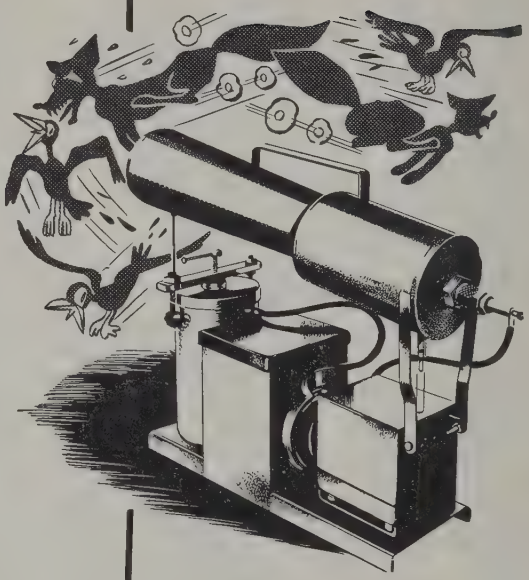
At least 95% of this year's currant crop had been set by spraying with hormones instead of by the old practice of cincturing, said the Minister for Agriculture (Mr. E. K. Hoar) recently. It is estimated that the new method saves labour to the value of £18,000 usually associated with cincturing and is likely to increase production to the extent of £50,000 each year.

He said that the success of the work was a tribute both to the officers of the Department of Agriculture, particularly Mr. L. T. Jones, who had developed safe and effective methods of using the hormone, and to the vignerons who had shown their receptiveness to new practices by the rapidity with which they had introduced hormone spraying following field demonstrations.

The Minister went on to say that it was particularly pleasing to find also that hormone spraying gave promise of more vigorous vine growth. The Department of Agriculture had investigated many aspects of declining vigour of currant vines for many years and had reached the conclusion that it was associated with inadequate root growth. Cincturing had undoubtedly interfered with root development and the fact that it could now be avoided by substituting hormone spraying promised better vines and better yields.

The provision of increased facilities as a result of the establishment of the Upper Swan Research Station enabled more detailed investigations to be conducted and some of these are already in progress. He felt sure that the investigations at the new station would result in increasing benefits to vignerons throughout the whole State.

Destructive PESTS Decrease Your PROFITS!



Instal the

"CONSOL THUNDERCLAP" SCARE GUN

in your Orchard, Vineyard or Farm

NO OTHER BIRD GUN HAS ALL THESE NEW FEATURES!

1. Attractive durable finish gives protection in all weathers.
2. Large capacity generator holds greater quantity of granulated Carbide.
3. Battery Box houses four dry cell batteries (battery life six months).
4. Low pressure diaphragm operates on only 4½ lb. pressure—a big saving on gas.
5. Firing mechanism is fully enclosed and is ruggedly designed for trouble-free service.
6. On/off Toggle switch for easy control.
7. 14mm. spark plug is easily replaced at any garage.
8. Pressure tested firing chamber of heavy steel is all electrically welded.
9. Carrying handle is conveniently placed for proper balance.

For Further Particulars Contact . . . .

GOLDSBROUGH MORT

INC. IN VICTORIA 1893

AND COMPANY LIMITED

MERCHANDISE DEPARTMENT

THE LOSS IN WEIGHT OF STORED JONATHAN APPLES

By F. MELVILLE, B.Sc. Agric., Senior Horticultural Adviser

THE Jonathan is recognised as a low density apple and light weight packs are often a problem with this variety. During 1954 a small scale test was carried out to illustrate the effect of handling procedure prior to cool storage on the loss in weight and quality of the fruit. Orchard pick Jonathans were obtained from the Illawarra Orchard Company, Karragullen and from Mr. A. McAlinden of Bridgetown. After subjecting the fruit to various pre-cool storage treatments, it was placed in commercial chambers at Illawarra and Tropical Traders Patersons Ltd., respectively.

Six cases of Jonathans harvested at Illawarra on March 2 were packed in seasoned dumps of standard measurements. The packs consisted of 175 and 193 counts. The packed cases were treated as follows:—

1. Two cases were wrapped in sulphite paper and cool stored immediately.
2. One case was kept one week in the packing shed before wrapping and placing in cool store.
3. One wrapped case was shed stored for one week before cool storage.
4. Two wrapped cases were shed stored for two weeks before cool storage.

At Bridgetown three cases of Jonathans were harvested on March 9, wrapped in sulphite paper and forwarded by rail to Perth where they were treated as follows:—

1. One case was placed in cool store on arrival.
2. One case was held in common store one week before cool storage.
3. One case was held in common store two weeks before cool storage.

At the commencement of the test the tare of the case and the net weight of fruit were recorded for both lots and similar details were obtained after 10 weeks storage. The gross weight of the pack was obtained immediately after the fruit was removed from cool store and the case reweighed after the fruit had been taken out to determine the net weight.

A summary of the weight variations is shown in the following tables.

TABLE 1.—SHOWING THE LOSS IN WEIGHT AFTER 10 WEEKS STORAGE OF JONATHANS EX ILLAWARRA HANDLED IN VARIOUS WAYS

Storage Treatment	Count	Weight at Picking February 2, 1954		Weight after 10 Weeks Storage April 13, 1954		Loss in Weight of Fruit
		Weight of Fruit.	Weight of Case	Weight of Fruit	Weight of Case	
		lb.	lb.	lb.	lb.	lb.
Immediate cool storage wrapped	175	42·5	10·5	41·25	10·25	1·25
do. do. do. do.	193	41·0	10·0	39·5	10·0	1·5
1 week shed stored unwrapped before cool storage	175	42·0	10·0	40·25	10·0	1·75
1 week shed stored wrapped before cool storage	175	42·5	9·5	40·25	9·25	2·25
2 weeks shed stored wrapped before cool storage	175	41·5	11·0	39·5	11·0	2·0
	193	41·0	10·0	39·0	10·0	2·0

NOTE.—The weight of the case does not include the lid.

TABLE 2.—SHOWING THE LOSS IN WEIGHT AFTER 10 WEEKS STORAGE OF JONATHANS EX BRIDGETOWN HANDLED IN VARIOUS WAYS

Storage Treatment	Initial Weight February 11, 1954		Weight after 10 Weeks Storage May 18, 1954		Loss in Weight of Fruit
	Weight of Fruit	Weight of Case	Weight of Fruit	Weight of Case	
	lb.	lb.	lb.	lb.	lb.
Immediate cool storage	41·25	11·5	40·0	12·0	1·25
1 week common storage before cool storage	40·75	10·5	39·25	11·0	1·5
2 weeks common storage before cool storage	41·5	11·75	39·5	12·0	2·0

NOTE.—The weight of the case does not include the lid.

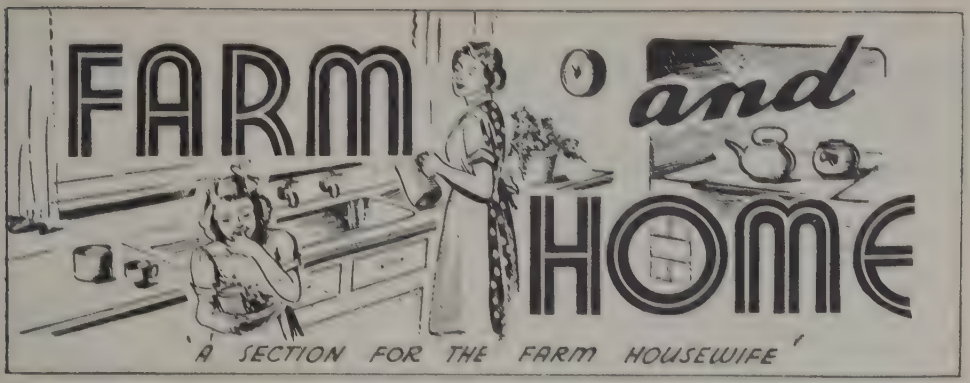
To obtain figures which are strictly comparable it would be necessary to use a much larger number of cases. However, from a commercial point of view the data given in the above tables illustrate the type of weight variation which can be expected with normal commercial handling. Generally the loss in weight during storage was not very great. Losses varied from 1¼ lb. to 2¼ lb. per case, being greatest for fruit subjected to various periods of shed storage prior to cool storage and least in the cases cool stored immediately after packing. There was practically no change in the tare of the Illawarra cases, but those from Bridgetown showed a slight increase during storage. It should be noted that the weights quoted are for unlidded boxes lined with cardboards.

The effect of delayed cool storage was more marked on the condition of the apples than on the loss in weight. When the fruit was removed from store 10 weeks after picking, it was found that apples subjected to various periods of shed storage were showing signs of overstorage. Varying degrees of yellowing, shrivelling, Jonathan Spot and breakdown were found and the fruit was generally of poor quality. On the other hand Jonathans cool stored immediately after packing were in good condition. The ground colour of Illawarra fruit was still showing a considerable amount of green—the Bridgetown apples which were harvested later and were two days reaching cool store in Perth were more forward. It was quite evident that the storage life of Jonathans had been considerably reduced by delay in cool storage.

Some difficulty is often experienced in getting adequate weight of Jonathans into the case and this is borne out by the weights obtained in these tests. However, the net weights are lower than would be normally expected, particularly in the case of the Bridgetown apples, owing to the limited selection of fruit available at the time of packing. Light weight packs are more likely to originate from insufficient weight going into the cases than from loss of weight during subsequent storage. The problem may be aggravated by the use of wraps which are too large for the fruit.

The common storage of Jonathans should be avoided if at all possible. The loss in weight incurred as a result of shed storage, although not great, must in view of the difficulty of getting adequate weight into the cases, be reduced to a minimum. The reduction in storage life and loss of fruit quality which result from improper handling are also good reasons for cool storing as soon as possible after picking.

Acknowledgment is made to Mr. H. C. Price, of the Illawarra Orchard Company, Karragullen; Mr. A. McAlinden, of Bridgetown and Tropical Traders Patersons Ltd., who by providing the fruit, packing facilities and storage, made these tests possible.



SUMMER DESSERTS

By BRENDA CLEEVE

DURING the hot summer days the housewife's thoughts naturally turn to the preparation of light and refreshing meals which are designed to tempt the appetite. Hot stimulating foods are no longer popular and an interesting dessert can add attraction to a salad meal. Even the lowly jelly lends itself to many variations and a few suggestions are given hereunder.

LEMON FOAM

Ingredients.

3 lemons.
3 cups water.
4 tablespoons sugar.
1 oz. gelatine.
2 egg whites.

To Make:—

1. Grate the rinds of the lemons.
2. Add the sugar and 2 cups of water. Boil together for 10 minutes.
3. Soak gelatine in the remaining 1 cup of water.
4. Remove syrup from stove. Stir in the soaked gelatine.
5. Add the juice of the lemons.
6. Allow to stand until the jelly is beginning to set.
7. Beat in the egg whites and continue beating until the mixture is thick and fluffy.
8. Add a few drops of green colouring.
9. Pour into serving dish and chill.
10. Decorate with cherries and angelica or fresh mint leaves.
11. This is sufficient for five or six people.

STRAWBERRY MARSHMALLOW

Ingredients.

1 packet strawberry jelly crystals.
1 cup of boiling water.
2 tablespoons strawberry jam.
½ cup cream or evaporated milk (unsweetened).
1 tablespoon lemon juice.

To Make:—

1. Dissolve the jelly crystals in the boiling water.
2. Allow to stand until beginning to set.
3. Beat the cream or evaporated milk until it will hold its shape.
4. Beat in the jam and lemon juice.
5. Beat in the jelly and continue with beating until thick.
6. Pour into serving dish.
7. Vary this recipe by using other tasty jams such as rasberry, blackcurrent or passionfruit pulp.

MULBERRY FLUFF

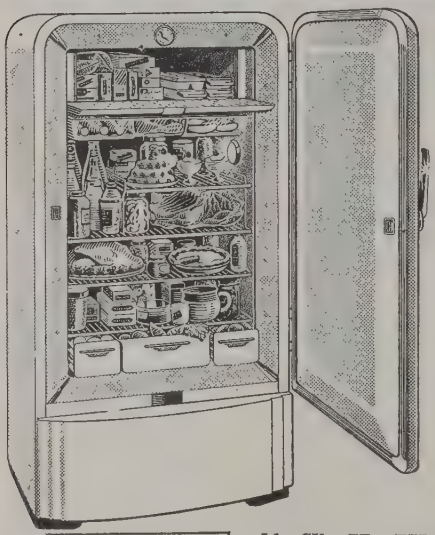
Ingredients.

1 packet red jelly crystals.
1 cup of boiling water.
1 cup ripe mulberries.
2 egg whites.
1 dessertspoon lemon juice.

Lovely to look at . . . delightful to own!

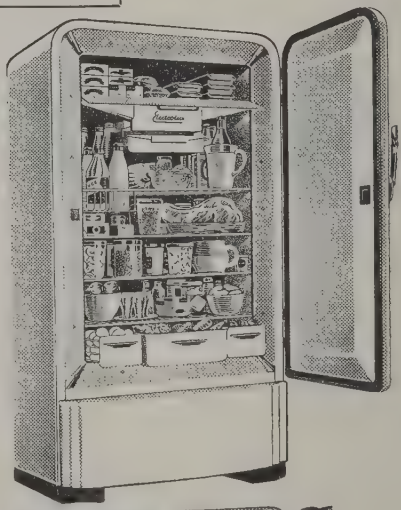
ELECTROLUX

World Famous Refrigerators



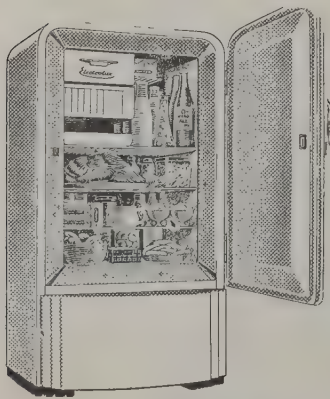
7.1 CU. FT. ELECTRIC SEALED UNIT (Motor) Model ST70—A completely new Electrolux, powered with precision-built hermetically sealed unit guaranteed for five years. Easy terms.

£175
Nett f.o.r. Perth



£162/10/-
Nett f.o.r. Perth

7.1 CU. FT. KEROSENE OR ELECTRIC (Motorless) Model LT701—Modern in styling . . . silent . . . efficient . . . economical. World famous for quality, with precision-built freezing unit guaranteed for five years. Easy terms.



3.1 CU. FT. KEROSENE or ELECTRIC (Motorless) Model LT310 — A brand new, popular size Model, with all the dazzling Electrolux features. Precision-built freezing unit guaranteed for five years. Easy terms.

£102/10/-
Nett f.o.r. Perth

1.7 CU. FT. KE
SENE or ELECTR
(Motorless) Mo
LT170 — You'll
amazed at what
new Electro
"Junior" ho
Ample space
food and upri
bottle storage. F
tures the latest d
racks. Precisi
built freezing u
guaranteed for
years. Ideal for fl
small homes or
holiday use. F
terms.

£69/10/
Nett f.o.r. Pert

DISTRIBUTORS:

Dalgety AND COMPANY LTD.

ELECTROLUX REFRIGERATORS ARE AVAILABLE FROM DALGETY'S OR THEIR DEALER IN YOUR DISTRICT

To Make:—

1. Make the jelly, using crystals and the boiling water. Add the lemon juice.
2. Allow to stand until it is starting to set.
3. Mash the mulberries. If very juicy drain off some of the juice.
4. Fold the mashed fruit into the jelly.
5. Beat the egg whites until stiff.
6. Fold into the jelly mixture.
7. Pour into serving dish. Chill.
8. Serve with extra mulberries.
9. If the fruit is sour add extra sugar to the egg whites when beating.

PASSIONFRUIT SPONGE

Ingredients.

1 packet pineapple or passionfruit jelly.
1 cup of boiling water.
2-3 tablespoons fresh passionfruit pulp.
1 banana.
½ cup cream or unsweetened, evaporated milk.

To Make:—

1. Dissolve the jelly crystals in the cup of boilng water.
2. Allow to stand until beginning to set.
3. Mash the banana and add to the passionfruit.
4. Beat the cream or chilled milk.
5. Add fruit and jelly and continue beating until thick and fluffy.
6. Pour into serving dish. Chill.
7. This serves 5-6 persons.
8. If the passionfruit are sour, extra sugar may be needed.

APPLE SNOW—WITHOUT EGGS

Ingredients.

1 packet lemon jelly crystals.
2 cups hot water.
1 teaspoon grated lemon rind.
1 dessertspoon lemon juice.
1 cup stewed apple drained and mashed.

To Make:—

1. Make the jelly, add lemon juice and rind. Allow to stand until beginning to set.
2. With rotary beater beat until frothy.
3. Add apple pulp and beat until almost set.
4. Add a few drops of green colouring.
5. Pour into a glass dish and chill.

TO MAKE A JELLY IN A HURRY

1. Place the crystals in a bowl. Add one cup of boiling water and stir until all the gelatine is dissolved. Then add one cup of iced water or ice chips.

2. Place crystals in a bowl. Add half a cup of cold water and soak a few minutes. Add one and a half cups of boiling water and stir until all the crystals are dissolved.

QUICKLY-MADE LAYERED JELLY

Layered fruit jellies can be prepared quickly by using a mixture of sliced or diced raw and cooked fruits. Stewed or tinned fruits usually sink in a jelly while raw fruits float. When the jelly is poured on, the fruits separate into layers as the jelly sets.

Raw pineapple and pawpaw should never be used in a jelly as they contain an enzyme which causes it to liquefy. They should be cooked until tender and then used.

BAKED ARABIAN PEARS

Ingredients.

1 lb. pears.
A few dates.
½ cup sugar.
1 cup cold water.
Few strips of lemon rind.

To Make:—

1. Peel the pears, cut in halves and remove the core.
2. Stuff the centre with dates and squeeze a little lemon juice over each one.
3. Place into a casserole with a few extra chopped dates.
4. Boil the sugar, water and lemon rind together for a few minutes.
5. Lift out lemon rind and pour the syrup over the pears.
6. Bake in a slow oven until pears are tender.
7. Serve with cream or custard.

BUTTERSCOTCH SAGO

Ingredients.

1 tablespoon sago.
2 cups cold water.
¾ cup brown sugar.
1 tablespoon butter or margarine.
¼ teaspoon vanilla.
1 level teaspoon spice.

To Make:—

1. Soak the sago in the cold water overnight.
2. Add the brown sugar, butter and spice and cook until the sago is thick and clear.
3. Add the vanilla.
4. Pour into serving dish.
5. This may be served warm or chilled.

APPLE CRISP

Ingredients.

1 lb. apples.
2 cups cornflakes, bread crumbs or cake crumbs.
2 tablespoons butter or margarine.
2 teaspoons cinnamon.
4 tablespoons brown sugar—use less if cake crumbs are used.

To Make:—

1. Grease a casserole and line with some of the cornflakes or crumbs.
2. Peel and slice the apples.
3. Place a layer of sliced apples in the dish.
4. Sprinkle with brown sugar, cinnamon and small pieces of butter.
5. Repeat the layers of cornflakes, apple and flavourings until all are used.
6. Finish the top with cornflakes.
7. Bake in a moderate oven $\frac{1}{2}$-$\frac{3}{4}$ of an hour until apples are tender and flakes crisp.
8. Serve hot or cold with custard or cream.

A MILLINERY HOOD MAKES A NOVEL BASKET

By BRENDA CLEEVE, Home Science Teacher, Education Department

A HANDY light shopping basket which will give good service for many years can be made easily and quickly from a millinery hood. The type of hood to use is that with a strong firm weave, and hoods of this type used for making beach hats have been available recently for approximately 2s. 6d. These are particularly suitable for basket making as they are usually in a natural shade which provides good backgrounds for decorations.

The handles of the basket are made of plaited seagrass, preferably the fine type as this is more pliable than the coarser weaves.

The decorations may be made from felt or raffia, tinted gum nuts or quongdong nuts, or if these are not available, some attractive decorations may be made from thick wool.

A small quantity of raffia and matching macrame or fine string will be required for stitching. If none of these is available crochet thread or stranded cotton can be rubbed with a piece of beeswax or candle and used as a substitute.

A sailmaker's needle, which has a three-sided point, is the most suitable sewing instrument as this slips through the straw easily. If a sailmaker's needle is not available, however, a thick darning needle or fine bodkin may be used.

DECORATIONS

The scheme of decoration lends itself to infinite variations acording to the inclination of the worker. Designs may be sketched in on the hood with pencil or chalk or the design may first be drawn on paper and cut out and spaced on the basket until the desired effect is achieved.

Coloured felt leaves and tinted nuts are obtainable at most handcraft stores and it is a simple matter to attach them to the basket with fine string. Country dwellers and picknickers may often obtain native nuts which can be tinted with paint or cycle enamel. These enamels are particularly suitable as they come in clear colours and are available in small tins. Use the paint sparingly and apply with a small brush for the best results. Variegated tonings may be obtained by stippling different colours over the nuts although this may re-

The shopping basket made from a millinery hood.

quire some practice as the colours are apt to run together if they are applied too liberally.

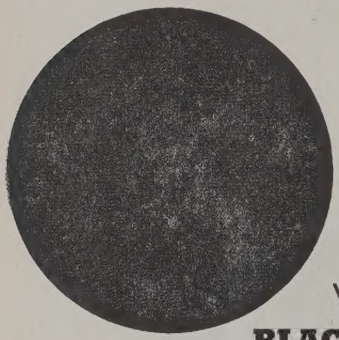
Excellent results may often be obtained by painting the nuts with coloured inks or water paints and then varnishing them to give a glossy finish.

The nuts which are purchased from the handcraft stores have holes bored through them or are fitted with wire loops which makes attachment a simple matter. Those prepared at home should be bored with a fine drill before colouring. Round or oval nuts can have a hole bored straight through the centre; gum nuts can be bored in two places near the base.

Leaves can be made from scraps of felt or old canvas. Cut a paper or cardboard shape and use this as a pattern. To mark veins on the leaves use marking pencils or ink, or alternatively burn the design into the felt using a fine steel knitting needle or wire skewer. Place one end of the needle in an old cork to facilitate handling and allow the other end to rest in the flame until red hot. Mark in the veins quickly with light strokes to avoid burning holes through the material. The leaves are attached to the basket by a few stitches and some interesting effects may be achieved by twisting the leaves before sewing them into place.

Similar patterns may be made for cutting out the flowers and it will be found that cutting to a pattern gives much better results than by cutting by guesswork. Simple outlines are easier to make and use and will wear better than those carrying small fringes or petals. The thicker quality felt gives better results than the thin material used in toymaking although this can be used effectively if padded underneath. Coloured buttons or wool may be used for the flower centres and poppies, daisies, petunias, dog roses and chrysanthemums are flowers which can be utilised as patterns.

'THIOTOX' 80 DISPERSIBLE POWDER



WIPE OUT

BLACK SPOT

AND

BROWN ROT

'Thiotox,' a new and outstanding organic fungicidal spray for fruit trees and vines

CONTROLS

- Black Spot on apples and pears.
- Black Spot on vines.
- Leafcurl and Brown Rot on apricots, peaches and other stone fruit.
- Fungus diseases on copper and sulphur shy varieties.

EFFECTIVE

- On any kind of fruit, leaves no visible residue.

SAFE

- To apply on all varieties of fruit at any time of the season.
- Harmless, causing no damage to flowers, fruit and foliage.

'THIOTOX' 80

New Organic Fungicide containing 80% TMTD (THIRAM)

AVAILABLE FROM YOUR USUAL SUPPLIER

THI.3V.4395

A DEPENDABLE PLANT PROTECTION PRODUCT

IMPERIAL CHEMICAL INDUSTRIES OF AUSTRALIA & NEW ZEALAND LIMITED

Alternative designs may be worked out with raffia using simple embroidery stitches. The raffia should be damped slightly before using to make it pliable and prevent splitting.

THE HANDLES

To make the handles, cut two pieces of seagrass about 16in. in length, finish off the ends by binding and oversewing with raffia and then sew firmly into position with the handles spaced evenly on either side of the centre line of the basket. Check to see that the handles are the same length and are not twisted before sewing them into position.

LINING

After the handles have been attached, the basket should be lined with coloured material in shades which tone with the decorations. Plastic material is very suitable for lining as it can be wiped over when soiled.

Lay the basket flat on a sheet of paper and mark round it with a pencil to give the pattern for the lining which is made of two pieces of material sewn together before inserting. When the lining portions are sewn together place them in position in the basket and secure by a few light stitches round the top.

FINISHING THE TOP

To complete the top edge of the basket cut two lengths of seagrass, one for the inside edge and one for the outside. Secure the ends of the seagrass by binding and oversewing with raffia as described for the handles.

Attach one piece at a time using firm stitches and if possible conceal the stitches between the strands of seagrass.

If the hoods have fringed edges, leave the fringe standing above the top edges of the seagrass until both pieces of seagrass have been sewn into position, then trim off the fringes level with the top.

To finish off the basket, top-sew the pieces of seagrass together using natural or coloured raffia. Two colours may be used worked in opposite directions to give a crossed effect. As raffia tends to wear rather quickly I prefer to use natural coloured raffia for this work, however, as the coloured raffia is apt to look untidy when it begins to fray.

WILSON & JOHNS PTY. LTD.

TELEPHONES { BA 3888 / BF 3241 / L 2447

NURSERYMEN AND SEEDSMEN

74 BARRACK STREET, PERTH

No. 1 Branch——————102 HIGH STREET, FREMANTLE

(Eugenia Smithii)

We offer large shrubs and trees in kerosene tins as illustrated and in addition to the list given below we have many other varieties to choose from

Trees for shade and ornamental purposes—
- Eugenia Smithii (Lilly Pilly)
- Tristania Conferta (Box-tree)
- Japanese Pepper
- Brachichiton Discolor
- Ceratonia Siliqua (Carob Bean)
- Poplars

Shrubs—
- Spirea, double (English May)
- Callitris (Rottnest Island Pine)
- Bottle Brush
- Biota, green and variegated
- Cupressus Stricta (Pencil Pine)
- Bauhinia Purpurea

ALL 20/- EACH

Shrubs—continued
- Oleanders, assorted varieties
- Euonymous Europus
- Lauristinus
- Ligustrum Sinensis (Flowering Privet)
- Genista Fragrans
- Pyracantha, assorted varieties
- Crataegus deciduous—Four varieties as follows—
  - Carreyii, red fruits
  - Mexicana, yellow fruits
  - Le Gralli, large red fruits
  - Durobivens, dwarf growing, red fruits
- Daphne, strong plants in 7in. pots

Country Orders: Freight additional. Free deliveries for these plants in near Metropolitan area

PRIMARY PRODUCERS!

Railway wagons are YOUR ASSETS DON'T WASTE THEM

PROMPT LOADING and UNLOADING means quicker turnround of wagons.

QUICKER TURNROUND means increased effective wagon loading capacity.

INCREASED CAPACITY means faster and better railway service for all.

BETTER SERVICE is our aim and **your** need. YOU CAN HELP yourself by helping Railways to keep the wagons moving.

- USE Government Railways **Insured Parcels** and **Cash on Delivery Parcels** systems
- ALSO, consign your goods at "Commission's Risk" and safeguard yourself

WESTERN AUSTRALIAN GOVERNMENT RAILWAYS

SUNRISE AND SUNSET TIMES FOR MARCH-APRIL, 1955

(Supplied by the Government Astronomer)

Times of sunrise and sunset for every fifth day, are given for a number of towns throughout the State. Times for a town not on the list may be estimated if its position in relation to one or more of the listed towns is known. The times given for sunrise are those of the first appearance of the top edge of the sun over a true horizon; those for sunset give the time of the sun's disappearance below a true horizon. Situation in a valley would make the sun appear to rise later, and on a hill it would appear earlier.

SUNRISE

Month.	Day of Month	Broome.	Port Hedland.	Onslow.	Carnarvon.	Yalgoo.	Geraldton.	Moora.	Kalgoorlie.	Southern Cross.	Merredin.	Perth.	Tammin.	Northam.	Narrogin.	Collie.	Bunbury.	Katanning.	Bridgetown.	Hopetoun.	Esperance.	Cape Leeuwin.	Albany.
Mar.	1	5·49	6·3	6·16	6·19	6·4	6·13	6·5	5·43	5·52	5·56	6·5	5·58	6·1	5·59	6·4	6·6	5·57	6·2	5·47	5·40	6·7	5·54
,, ...	5	5·51	6·5	6·18	6·22	6·8	6·17	6·9	5·47	5·56	6·0	6·9	6·2	6·5	6·3	6·8	6·10	6·1	6·6	5·51	5·44	6·11	5·58
,, ...	10	5·52	6·6	6·19	6·23	6·10	6·18	6·12	5·50	5·59	6·3	6·12	6·5	6·8	6·6	6·11	6·13	6·4	6·9	5·54	5·47	6·14	6·2
,, ...	15	5·53	6·8	6·21	6·26	6·13	6·21	6·15	5·53	6·2	6·6	6·15	6·8	6·11	6·9	6·14	6·16	6·7	6·12	5·57	5·50	6·17	6·5
,, ...	20	5·55	6·10	6·24	6·29	6·16	6·25	6·19	5·57	6·6	6·10	6·20	6·13	6·16	6·13	6·18	6·20	6·12	6·17	6·2	5·55	6·22	6·10
,, ...	25	5·56	6·11	6·25	6·30	6·18	6·27	6·21	5·59	6·8	6·12	6·22	6·15	6·18	6·17	6·22	6·24	6·16	6·21	6·6	5·59	6·26	6·14
,, ...	31	5·57	6·12	6·27	6·32	6·21	6·31	6·25	6·3	6·12	6·16	6·27	6·20	6·23	6·21	6·26	6·28	6·21	6·26	6·11	6·4	6·31	6·19
Apl.	1	5·57	6·13	6·28	6·33	6·22	6·32	6·26	6·4	6·13	6·17	6·28	6·21	6·24	6·22	6·27	6·29	6·22	6·27	6·12	6·5	6·32	6·20
,, ...	5	5·58	6·14	6·29	6·35	6·24	6·34	6·29	6·7	6·16	6·20	6·30	6·23	6·26	6·25	6·30	6·32	6·24	6·29	6·14	6·7	6·34	6·23
,, ...	10	5·59	6·15	6·30	6·37	6·27	6·36	6·32	6·10	6·19	6·23	6·33	6·26	6·29	6·28	6·33	6·35	6·27	6·32	6·17	6·10	6·37	6·26
,, ...	15	6·1	6·17	6·32	6·39	6·30	6·39	6·35	6·13	6·22	6·26	6·37	6·30	6·33	6·32	6·37	6·39	6·32	6·37	6·22	6·15	6·42	6·31
,, ...	20	6·1	6·18	6·34	6·41	6·32	6·42	6·38	6·16	6·25	6·29	6·40	6·33	6·36	6·36	6·41	6·43	6·36	6·41	6·26	6·19	6·46	6·35
,, ...	25	6·2	6·19	6·35	6·43	6·35	6·45	6·41	6·19	6·28	6·32	6·43	6·36	6·39	6·39	6·44	6·46	6·39	6·44	6·29	6·22	6·49	6·38
,, ...	30	6·5	6·22	6·38	6·47	6·39	6·49	6·45	6·23	6·32	6·36	6·48	6·41	6·44	6·43	6·48	6·50	6·44	6·49	6·34	6·27	6·54	6·43

SUNSET

Month.	Day of Month	Broome.	Port Hedland.	Onslow.	Carnarvon.	Yalgoo.	Geraldton.	Moora.	Kalgoorlie.	Southern Cross.	Merredin.	Perth.	Tammin.	Northam.	Narrogin.	Collie.	Bunbury.	Katanning.	Bridgetown.	Hopetoun.	Esperance.	Cape Leeuwin.	Albany.
Mar.	1	6·17	6·33	6·48	6·55	6·46	6·55	6·51	6·29	6·38	6·42	6·53	6·46	6·49	6·48	6·53	6·55	6·48	6·53	6·38	6·31	6·58	6·47
,, ...	5	6·15	6·31	6·46	6·52	6·42	6·51	6·47	6·25	6·34	6·38	6·49	6·42	6·45	6·43	6·48	6·50	6·43	6·48	6·33	6·26	6·53	6·42
,, ...	10	6·10	6·26	6·41	6·47	6·36	6·46	6·41	6·19	6·28	6·32	6·42	6·35	6·38	6·37	6·42	6·44	6·36	6·41	6·26	6·19	6·46	6·35
,, ...	15	6·7	6·22	6·36	6·42	6·31	6·40	6·34	6·12	6·21	6·25	6·36	6·29	6·32	6·30	6·35	6·37	6·30	6·35	6·20	6·13	6·40	6·28
,, ...	20	6·3	6·18	6·32	6·37	6·26	6·35	6·29	6·7	6·16	6·20	6·30	6·23	6·26	6·24	6·29	6·31	6·23	6·28	6·13	6·6	6·33	6·21
,, ...	25	5·59	6·14	6·28	6·33	6·20	6·29	6·23	6·1	6·10	6·14	6·24	6·17	6·20	6·17	6·22	6·24	6·16	6·21	6·6	5·59	6·26	6·14
,, ...	31	5·53	6·7	6·20	6·25	6·12	6·20	6·14	5·52	6·1	6·5	6·15	6·8	6·11	6·8	6·13	6·15	6·7	6·12	5·57	5·50	6·17	6·5
Apl.	1	5·53	6·7	6·20	6·24	6·11	6·19	6·13	5·51	6·0	6·4	6·13	6·6	6·9	6·7	6·12	6·14	6·5	6·10	5·55	5·48	6·15	6·3
,, ...	5	5·49	6·3	6·16	6·20	6·6	6·14	6·7	5·45	5·54	5·58	6·8	6·1	6·4	6·1	6·6	6·8	6·0	6·5	5·50	5·43	6·10	5·57
,, ...	10	5·46	6·0	6·13	6·16	6·1	6·11	6·3	5·41	5·50	5·54	6·3	5·56	5·59	5·57	6·2	6·4	5·55	6·0	5·45	5·38	6·5	5·52
,, ...	15	5·42	5·56	6·8	6·11	5·57	6·5	5·57	5·35	5·44	5·48	5·57	5·50	5·53	5·51	5·56	5·58	5·49	5·54	5·39	5·32	5·59	5·46
,, ...	20	5·40	5·53	6·5	6·7	5·52	6·0	5·52	5·30	5·39	5·43	5·52	5·45	5·48	5·45	5·50	5·52	5·43	5·48	5·33	5·26	5·53	5·40
,, ...	25	5·35	5·48	6·0	6·2	5·46	5·54	5·46	5·24	5·33	5·37	5·46	5·39	5·42	5·38	5·43	5·45	5·36	5·41	5·26	5·19	5·46	5·33
,, ...	30	5·33	5·46	5·57	5·59	5·43	5·50	5·42	5·20	5·29	5·33	5·41	5·34	5·37	5·34	5·39	5·41	5·31	5·36	5·21	5·14	5·41	5·28